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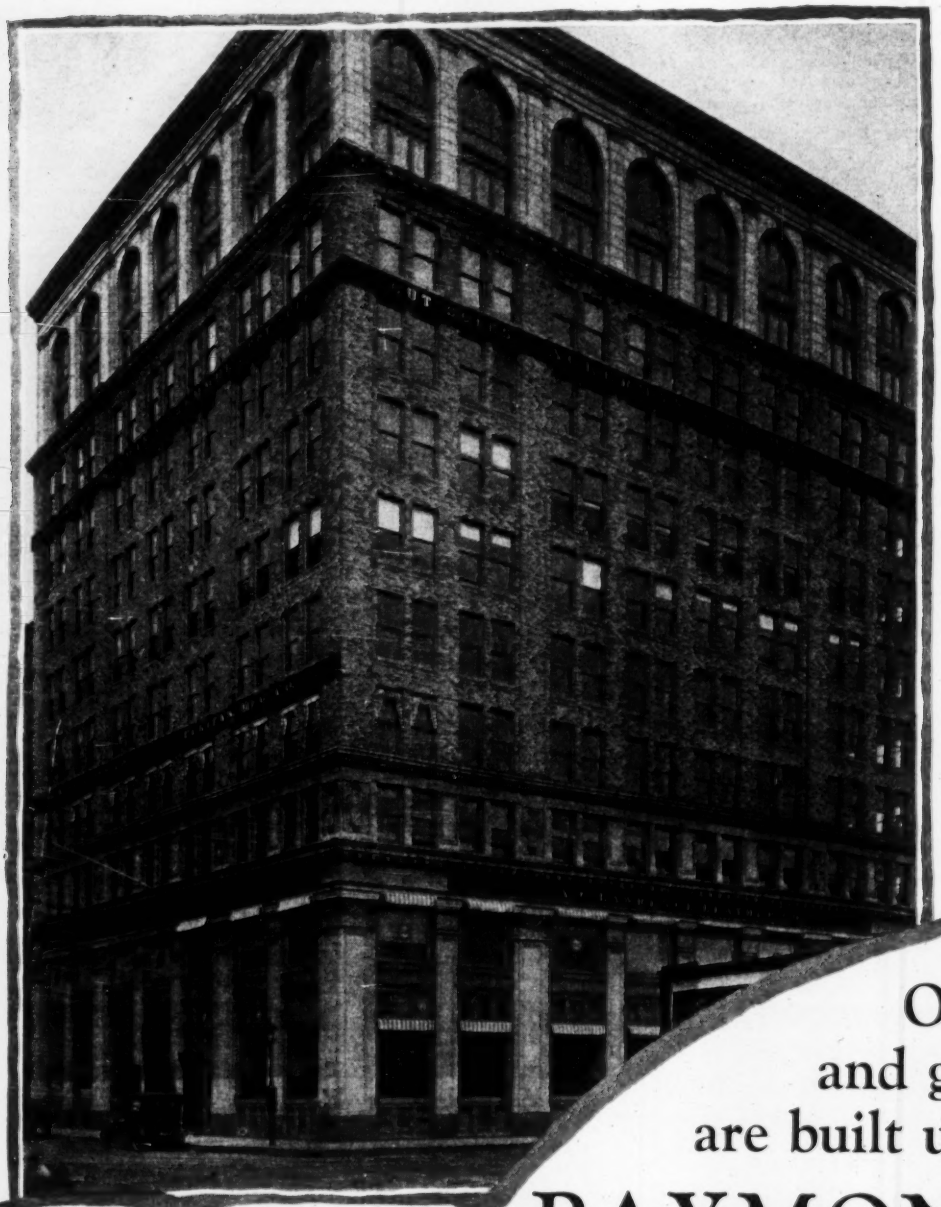

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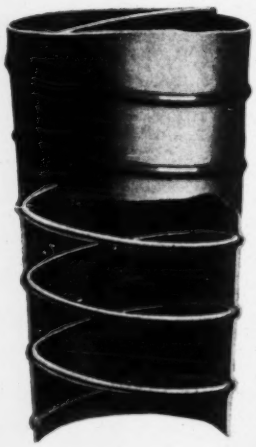

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F. E. SCHMITT, *Editor*

Volume 103 NEW YORK, SEPTEMBER 5, 1929 Number 10

The Dirigible Has Its Day

TWO events stand out on a month of splendid achievement in air transportation—the flights of the "Graf Zeppelin" and the successful tests of the first metal-clad dirigible. Vanishing eastward into the Atlantic mists at midnight, Aug. 7, the "Graf Zeppelin" reappeared at its starting point 21 days and a few hours later, nosing down to haven out of the western sky after a truly remarkable trip around the world. Man had never before traveled so far at such a fast pace. The flight was of inestimable value in elevating the performance of lighter-than-air craft to a higher plane of dependability, and its success constituted a well-deserved reward for those who have pinned their hopes to this means of air travel. When interest in this flight was at its maximum another event focused attention on the dirigible. This was the completion of several test flights of the first metal-clad airship, a dirigible being preened in Detroit for delivery to the U. S. Navy. In this new ship a complete departure is made from the use of trussed framework by substituting therefor ring girders and longitudinal struts to take the tensile stresses and to assist the thin skin of aluminum alloy in retaining the ship's shape. With the advent of this metal-clad ship, we thus have rivalry of types within the dirigible field itself as well as competition between dirigibles and planes. This augurs well for air travel development in general.

Transportation Development

FROM a broader viewpoint, these developments in the dirigible field merely take their place beside many other recent happenings in the field of transportation, all of far-reaching consequence. Regular air communication from the United States to South America and down the coast as far as Chile was opened some weeks ago. About the same time the air mail system achieved a significant anniversary, its third, bringing to a close a year of phenomenal growth, during which the air postal service came to be used in all circles of the country and an important rate reduction was made to further this progress. The airplane has made a record in a most remarkable performance of endurance flying with refueling in the air, the most recent record almost doubling the best previous performance. Another flight which comes even closer to demonstrating the possibilities of refueling in the air was successfully completed two weeks ago, when a plane flew from Spokane, Wash., to New York City and return without alighting. Construction of passenger dirigibles of greater size than the huge machines already built and of equal size to those to be built for the U. S. Navy will soon be begun in the United States. Such is the progress of air transportation. That some of the older means of transport respond to the rivalry of the new ones by their own efforts at better performance is shown by what the steamship accomplished during the same month—cutting the transatlantic crossing time to less than five days and bettering the quickest previous crossing by nearly half a day. In due time, no doubt, something new will be heard also from the railway, which has already combined its facilities with bus transportation and airplane travel in important instances. Persistent efforts are still being made to arrange new transcontinental rail routes by groupings which will pass I.C.C. muster and still be possible from the standpoint of financial set-up. With transportation progress going ahead at a rate that opens new possibilities almost daily, whoever would look forward into the future dependably has need to make note of these changes and consider where they may lead.

Beating Around the Bush

MUCH of the present dissatisfaction with laws and their enforcement is due to the predilection of legislators to take the most involved possible method of achieving a given object. Connecticut, for example, wants to drive from its highways automobiles in a dangerous state of dilapidation. Some states refuse to license such cars, a simple and effective solution of the problem. Connecticut, however, enacts a statute providing that if and when an automobile unfit for further service falls into the hands of an automobile junk dealer, it must be dismantled, not reconditioned for service. Since it is manifest that any piece of machinery can be rejuvenated by the expenditure of sufficient money and labor, interpretation of the law may prove difficult. Furthermore, the law, if enforced, will remove a comparatively small proportion of the cars in bad condition, for it does not affect those privately owned. The chief function of a motor vehicle department is to keep the highways safe; why delegate the task to the junkmen?

Can the States Do It?

GENERAL approval is sure to greet President Hoover's proposal to have a commission study the administration of public lands in the Western states, with a view to determining how it might be improved, and specifically whether state administration would be desirable. One might wish that he had not complicated this proposal by his own specific suggestions—that grazing and desert lands be ceded to the states, that mineral lands remain in federal control and that the reclamation act be amended radically—for they are sure to direct and bias the studies of the proposed commission. With such pointed Presidential suggestions before it, it will be only human for the commission to seek ways of applying the President's views, in place of finding facts and analyzing

administrative principles. Apart from this unfortunate bias, study of the whole subject of land policies is to be welcomed. Present practices have continued unchanged thoroughout a quarter-century and may be badly out of gear with the requirements of today. Questions of great interest are involved in any such study, and many weighty considerations present themselves both as to land policy and as to change of the reclamation system. The basic question, however, is whether the states are capable of administering the lands effectively. When President Roosevelt inaugurated his famous conservation program, it was necessary to save irreplaceable resources from early destruction. Federal administration provides the means, as against private ownership or state administration. If conditions have now changed so that the states can and should become partners with the federal government in constructive management and development of natural resources, determination of this fact will be most gratifying and valuable. The magic of the term "conservation" should not remove the subject from the sphere of thorough, practical study.

The Contest Skyward

THE long-suppressed desire to construct a building to top the famous Woolworth tower has come to fulfillment with a vengeance. Indeed, the Woolworth tower is almost forgotten in the race skyward that has developed in New York City. At the moment two structures are actively under construction and a third has just been announced, all of which exceed by a safe margin the 792-ft. height of the Woolworth Building.

The first of the projects was a structure of 67 stories, known as the Reynolds Building and planned for the Grand Central region. Following closely upon this announcement, the Bank of the Manhattan Company changed a 47-story project on Wall Street into one of 63 stories, 840 ft. high and advertised as the tallest in the world. Meantime the Reynolds site and plans had been sold to Walter Chrysler, the motor manufacturer, who revised the plans so as to exceed the height of the Bank of the Manhattan Company building. Several revisions upward ensued on both structures, some after the buildings were under construction, until at the moment the Chrysler building is the taller.

Last week, however, former Governor Alfred E. Smith announced that he had accepted a position as head of the Empire State Building Corporation, an organization formed to replace the old Waldorf-Astoria Hotel with an 80-story building "close to 1,000 ft. high" and characterized as the largest single real estate undertaking in the history of the country.

Such activities are axiomatic of the present state of mind engendered by prosperity and confidence in the future. Other considerations than economy, of course, govern the determination to erect these structures. It is probable that greater convenience for tenants and certainly greater floor space on the same plot can be secured with other designs than with a slender tower-type building. However, these tall structures will afford an answer to the question as to whether tenants will as gladly travel 75 stories in an elevator as they do 25 stories and still pay the same or greater rent. Technically and structurally the tall building offers no unusual problems to the engineer, at least in so far as ultimate safety of the frame is concerned. Economy of steel and comfortable rigidity are both somewhat more questionable. We are still far from a solution to the problem of economical designing against wind. If the excessively tall buildings do nothing else they may stimulate a much broader and more penetrating study of wind action than has yet been undertaken, besides throwing light on the practical question of the utility and desirability of this new generation of skyscrapers.

Diversion on a Grand Scale

WITH the comprehensive sketch of the great diversion floodway through the Tensas basin presented this week, the dominant feature of the Mississippi River control system—namely, side-channel diversion—comes into view for detail scrutiny. By way of this floodway and the Atchafalaya floodway beginning at its foot, the Mississippi River is to be provided with a temporary floodtime side channel extending from the Arkansas River to the Gulf. It is the greatest flood-diversion scheme ever conceived.

There are many hydraulic aspects of the project that are of commanding interest, but perhaps they may be disregarded at present in view of the sensational situation that has developed within the last two months—namely, stoppage of the entire work at its very inception by court order pending a hearing on the plea that human rights are being violated by the government officials in going ahead and preparing to turn floodwaters over certain lands for the protection of others, without compensation to the victims of this procedure. Hardly a case is to be found in our national history where such a procedure was attempted. The fact that it is done under the explicit instructions of President Coolidge does not make it any the more pleasant to contemplate.

Months ago we said and reiterated that the Mississippi project is utterly unsound, quite aside from the doubts surrounding its operating efficiency. It is unsound because its cost is wholly unknown and because the project has not been compared with alternative projects. Not only was the cost unknown twenty months ago, when the Chief of Engineers placed his estimate of $296,400,000 before Congress, but it is unknown today. There is no knowledge of the values which will be destroyed by the construction of the floodway, as there is also no knowledge of the values to be created by the complete flood protection of the valley when, as and if accomplished. Thus the Mississippi project is the first great undertaking for many years which has been gone into by sheer impressionism, without knowledge of cost, without attempt at comparing alternative solutions as to cost and benefit.

When the pending lawsuit of the Boeuf basin landowners is decided, there will be something definite on which to appraise the costs of the present scheme. If this new information is to have useful application, it will logically lead to comparison of the wide floodway now projected with a narrower floodway and perhaps alternative locations. Such studies are obviously required by sound engineering and business sense. They may mean some delay—though there is no present hurry about building the works in the Tensas basin—but even a long delay would not be a valid argument against following the right course.

Here in the Boeuf floodway also is presented outstanding application of the famous Jadwin "fuseplug levee" idea. A low levee, 30 miles long, is to permit

the water to flow over its crest and supply the million second-feet of inflow to the great diversion channel. This is about four times the flood flow of the Ohio at Cincinnati, or four times the amount that is to be discharged through the Bonnet Carré floodway at New Orleans. The tremendous volume of water is to be discharged over the top of an earth overflow dam, with a crest length of 30 miles.

No one has any experience with a spillway of this kind. Its working will not be known until a new great flood, much higher than the destructive inundation of 1927, sweeps down the valley. On this new scheme is centered the whole project in the form now being carried out. In the future it may compel unpleasantly serious study.

Refuse-Disposal Pitfalls

PITFALLS surround the American city about to invite bids for a refuse-disposal plant. That some of these, and perhaps the deepest and most treacherous, are of the city's own digging only makes the matter worse. The dangers are further increased because most cities are unaware of their existence.

One of the reasons for this unfortunate state of affairs is that city councils generally do not consider refuse collection and disposal as an engineering problem, like sewage disposal or water supply, to be put in competent hands. Instead, they take a junketing trip, then put themselves at the mercy of manufacturers, who at best are asked to bid on general specifications and at worst (which is frequently) are instructed to make their own plans and specifications and are permitted to set up guarantees to suit themselves and their particular type of plant.

Now and then one of our cities, after floundering about for some months or years, turns the problem over to an engineer. Even so there are more than likely to be pitfalls. For a hundred specialists in water supply and sewage disposal or a thousand salaried municipal engineers with considerable experience in those fields, there are but one or two engineers, either consulting or in regular city employ, that are experienced in designing and writing contract requirements for refuse-disposal plants. For an explanation of this fact one travels around the circle and comes back to the average councilman, who does not, as we said at the start, recognize garbage and refuse disposal as an out-and-out problem in engineering.

The foregoing reflections are prompted by the garbage- and refuse-disposal situation at San Francisco, which again and again has been the subject for news and comment in our columns.

Fortunately, the latest turn of affairs at San Francisco, after a long period of dabbling and dillydallying by the local board of supervisors (corresponding with the city council elsewhere), was to authorize the city engineer to make a tour of inspection of Eastern incinerators and report his recommendations for future action before the city undertakes to build and operate an incinerator. A summary of the resulting advice appears elsewhere in this issue.

As might be expected in what we trust will be only a preliminary report, most of the recommendations are quite general in character and are along lines followed by most engineers of late, when such have been employed for a similar purpose. That is, they do not advise the city to have some thoroughly experienced engineer design an incinerating plant suited to San Francisco refuse and other governing conditions, write specifications and set up contract guarantees and tests, but recommend that each bidder submit his own plans and state (along specified lines) his own guarantees. The sole exception to this is a rather general provision against chimney-top nuisance. We venture to say that Mr. O'Shaughnessy would have been the first and loudest in protesting against any such vagueness in specifications and guarantees for the Hetch Hetchy water-supply project, so ably carried on for years past under his direction.

We are well aware, as we have intimated, that this sort of thing is common in refuse-disposal contracts in the United States; which is only to say that refuse-disposal engineering awaits development in America, or if developed awaits recognition in municipal practice. We are also aware that if the San Francisco supervisors ever stop their backing and filling Mr. O'Shaughnessy may take the lead among American city engineers in producing incinerator specifications and guarantees that will protect the city and be fair to the contractor at every point.

One feature of Mr. O'Shaughnessy's recommendations deserves special comment. He advises that bids be taken on incinerators and their housing combined. In the present state of the art of letting such contracts, this seems highly commendable, objectionable as it might be if the art were nearer perfection. Until incinerator specifications are more nearly standardized than they are now, there is much to be said for this proposed combination, since the type of incinerator and also provisions for storage of refuse offered by each competing bidder may affect materially the area and height of the building. Uppermost among objections to an inclusive contract is that a concern well organized and equipped to supply an incinerator might be at a great disadvantage in having to provide a building in a distant city.

Significant also is Mr. O'Shaughnessy's omission of heat utilization from his recommendations. This is in line with both the teachings of American experience and the resulting practice for some years past. At the same time it makes stand out in high relief the extremes in heat utilization and in salvaging operations to which the city of Glasgow has gone in its recently built immense refuse destructor, described briefly last week. The article clearly indicated that it is yet too early to do more than guess whether the huge capital outlay for the Glasgow destructor, largely augmented by the heat-, clinker- and metal-utilization elements of the plant, will prove to be justified.

One thing is certain: If under the better municipal conditions common to British as compared with American cities there are interdepartmental and other difficulties to be met at Glasgow, such difficulties would be greater and more serious in the United States. Mr. O'Shaughnessy is therefore wise in advising the San Francisco authorities not to attempt heat utilization, even for works purposes. For some years to come, at least, American cities will do well to continue their current practice of confining capital investment to burning their refuse. They should also continue, as most of them do, to keep the volume of refuse incinerated to the lowest possible figure, by excluding everything that can be disposed of otherwise at less expense without creating a serious nuisance.

Bridge of Unusual Design Replaces Ohio River Crossing of Big Four at Louisville

Design of 547-Ft. River Spans Influenced by Erection on and Within Old Trusses—Separate Wind Chord—Pin-Connected Hangers Carry Floor beams Below Bottom Chord—Foundation and Viaduct Reconstruction

By J. B. Hunley

Engineer, Bridges and Structures,
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FIG. 1—UTILIZING AN OLD E-30 BRIDGE AS FALSEWORK FOR ERECTING A NEW E-70 STRUCTURE
The Ohio River crossing of the Big Four at Louisville, Ky. Travelers are of timber and run on a track on the top chord of the old spans.

DURING the past year the Cleveland, Cincinnati, Chicago & St. Louis Railway Company (Big Four) has been engaged in renewing the Ohio River bridge of the Louisville & Jeffersonville Bridge & Railroad Company, as well as the Indiana and Kentucky approaches. The structure provides a route for the interchange of important freight traffic between the Big Four and its southern connections and has also been used by the traction cars of the Interstate Public Service Company. It was started in 1889, but completion was delayed by the panic of 1893 and later by several accidents, the most serious of which was the destruction by a hurricane of two of the long spans which had been nearly completed. The bridge therefore was not put into service until 1895.

The bridge consists of three 547-ft. single-track through-truss spans over the channel, flanked by two 338-ft. spans on the Kentucky side and one 208-ft. span on the Indiana side. The Indiana approach consists of a single-track viaduct 5,000 ft. long, while at the Louisville end of the bridge there is a Y approach consisting of a double-track viaduct 2,600 ft. long leading to the Louisville & Nashville yard at East Louisville and connecting with the tracks of the Interstate Public Service Company and a single-track viaduct connecting with the bridge company's freight house and yard in Louisville as well as with the passenger station at Seventh St.

The three approach viaducts and the truss bridge, with the exception of the four channel piers, were completely renewed. Owing to the character of traffic handled, a double-track structure was not considered necessary, and it was possible to take the bridge out of service during the reconstruction, both of which factors influenced the new design.

The loading used in the original design was about equivalent to E-30, but due to many poor details and the lack of consideration given to other loads and forces, the structure, even with the rating stresses, had a computed capacity of less than the designing load. For many years it had been necessary to reinforce various local failures, and in 1923 all heavy traffic was removed and detoured. Even under the lighter loading, defects continued to develop at an equally rapid rate, particularly in the viaducts, and later all traffic was suspended except that of the traction cars.

Principal interest in the renewal work centers on the three 547-ft. spans over the river channel. Erected on the old bridge as falsework and necessarily placed within the old trusses, the new trusses are unusually narrow. It was therefore necessary, in order to provide lateral rigidity, to use a separate wind chord outside of the main trusses. The use of this wind chord made necessary some form of articulation between it and the main bottom chord, since the elastic actions of the two chords would be dissimilar, and the problem was solved by carrying the floorbeams on pin-connected hangers below the bottom chord. This article covers principally the design and erection of these three unusual spans. It

also touches briefly on the foundation work and viaduct reconstruction.

Foundations—The four channel piers, while comparatively small, were in excellent condition. They are of concrete, faced with oolitic limestone, the two north piers being founded on rock and the other two on cemented gravel. The three shore piers consisted of steel shells filled with concrete, the one on the north end being on rock and the two at the south end on clusters of wood piling. These steel piers were very slender and there was evidence that they were not in the best of condition. They were therefore completely incased and extended, being so designed that the incasement would carry all of the future load independent of the old pier. The new footing of the north pier was carried to rock, while the south footings on the Kentucky shore were erected on wood piling. The shafts were heavily reinforced, and the incasement on both sides was tied together by 1¼-in. rods spaced about 4 ft. on centers, passing through the old piers. The upper 10 ft. of the shell and the filling were removed and replaced with concrete.

The upper course of two of the stone piers in the river had cracked, probably as a result of ineffective expansion bearings under the old spans. To insure against further failure of this sort and also to afford resistance to a too rapid lateral distribution of the new and heavier imposed loads on the bridge seats, the tops of these four piers were incased or girdled for a depth of 12 ft. This incasement was heavily reinforced and hooped, being tied together by rods set in channels cut in the top course, and lower down by rods passing through the pier. All of the concrete used was proportioned on a strength basis, maintaining the specified water-cement ratio and controlling the workability with variation of the amount and proportion of aggregates.

Approaches—The total length of the new viaducts is about 7,000 ft., and they range in height from 25 to 65 ft. Although no unusual difficulties were encountred in their design or construction, several details are worthy of note. The tower spans are all 30 ft., while the intermediate spans, because of street crossings, etc., vary in length from 40 to 75 ft. The top surface of the bearing plates under the intermediate spans is curved to give line bearing and to fix, within narrow limits, the point of application of the load to the column cap. By this means eccentric loading of columns can be reduced to a minimum.

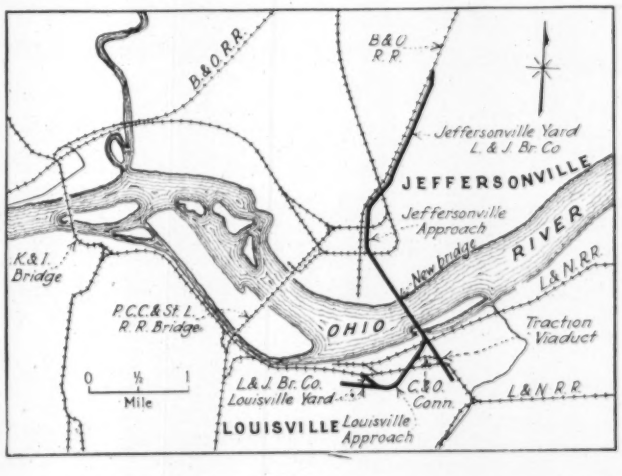
In one of the four columns of a tower, the holes in the sole plates were made to fit the anchor bolts snugly, while in the sole plates of the three other columns the holes were enlarged and the contact surfaces between the plates well lubricated when the bents were erected. This simple method of providing for expansion in the tower bases is noticeably effective up to the present time, and it is hoped that it will serve to eliminate the splitting of pedestals so frequently observed where no provision is made for expansion.

Another unusual detail is used on the curved portions of the viaduct, where the entire structure, including girders and bents, is tilted to correspond with the superelevation of the tracks, the use of tapered ties being thus avoided; at the same time lateral forces at balanced speeds are reduced.

Superstructure Design—The 207-ft. and 338-ft. spans are of usual form and have eight and ten panels respectively. The trusses are 24½ ft. center to center, with curved top chords, and have depths at the center of the spans of 40 and 60 ft.

The design and construction of the three 547-ft. spans was influenced to a considerable extent by the method of erection to be used. The existing piers were too short to permit placing the new trusses on the outside of the old span and erecting them as cantilevers, and the depth of water, about 45 ft., and requirements of navigation made the use of falsework somewhat hazardous and most undesirable. There was left the alternative of building the new spans within the old trusses, using the existing spans as falsework. While it was not the intention to fix in advance the method of erection to be used by the contractor, it was assumed with considerable assurance that the suggested method would appeal to him as the cheapest and most feasible, and the design was based wholly on this assumption.

The old spans had eighteen panels of equal length and were 546 ft. 6 in. center to center of end pins. The trusses were 84 ft. deep and 30 ft. on centers. The new spans were made 90 ft. deep, which brought the new top chords well above the old, and sixteen panels were used, to avoid interference at panel point splices and at floorbeams. To provide the necessary clearance for erection, the new trusses could not be made more than 24 ft. 6 in. center to center. This distance gave ample width for a single track, but was considerably less than that desirable for a span of this length and depth. However, by using a separate wind chord which could be placed after



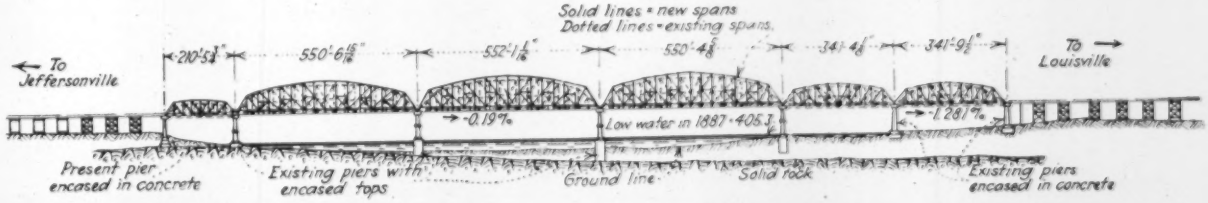


FIG. 2—LOCATION PLAN AND ELEVATION OF OHIO RIVER CROSSING OF BIG FOUR AT LOUISVILLE, KY.

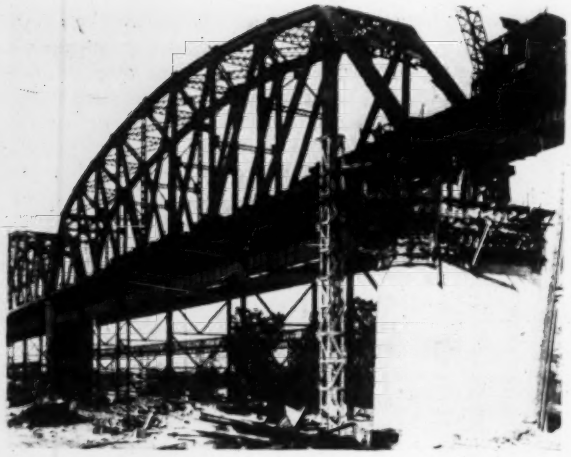


FIG. 3—CONSTRUCTING THE TWO 338-FT. SIDE SPANS ON FALSEWORK
Note holes drilled in old steel pier for tie rods. Incasement of near pier has been completed.

the old spans were removed, a bottom lateral system of sufficient stiffness could be provided, as the old structure would not control its width. By extending the lower portions of the floorbeams, which hang entirely below the main bottom chord, it was possible to support these independent chords at a reasonable distance out from the end of the beam, and they were made 30 ft. center to center. This distance is reduced at the end panel, the chords being drawn in until they pass inside of the main bearing shoes. The bottom laterals are in the plane of and attached to this wind chord.

The use of this auxiliary chord to resist lateral forces only, necessarily introduced other unusual features. The main chord under full live load will theoretically elongate about $\frac{1}{8}$ in. per panel, or 2 in. in the length of the span, while there will be no corresponding elongation of the wind chord. This condition called for some means of articulation between the two chords, and the floorbeams are therefore suspended from pins at the panel points, except at the center of the span, where a stiff connection is provided to transfer to the main chords the longitudinal force which will be carried through the floor system to the wind chords. The pins from which the floorbeams are suspended are 8 in. in diameter and are designed for only 50 per cent of the usual permissible bearing stress, to prevent wear or cutting. They do not pass through the bottom chord, but are suspended from jaws attached to the posts. The pins are provided with nuts to clamp the jaws, and another pair to jam against the inner face of the leaves of the bottom chord. They can be lubricated by oil holes in the tops of the floorbeam hangers which go over the pin and between the jaws on the post.

To compensate partly for the difference in elongation of the two chords and to reduce transverse bending in the floorbeams, the wind chord was fabricated $\frac{1}{8}$ in. longer per panel than the main chord. However, provision for expansion was required at both ends of the wind chord because of the rigid connection between the wind chord and the truss at the center of the span. The ends of the wind chords, which are brought in between the main shoes, bear against vertical segmental rollers, attached to the castings. These take the lateral reaction, while the dead-load reaction of the half-panel is taken by a rocker arm on the pier top.

It was also necessary to control and account for the relative deflections of the top and bottom lateral systems. By using a low unit stress of about 8,000 lb. in designing the wind chords, the lateral deflection of the lower system under maximum wind loading will never be more than 1 in. greater than that of the upper system, and the web members of the trusses were designed to take this 1 in. bending about the bottom struts of the sway bracing. In fact, the force required to bend these members transversely is about equal to or less than the maximum wind load at any lower panel point, so that by their inherent stiffness they will immediately begin to transfer a portion of the wind load from the lower to the upper system, maintaining equilibrium; the top laterals, portals, etc., were designed to take care of this overload.

The design of these spans contemplated placing the new bottom chords above the old floorbeams and erecting

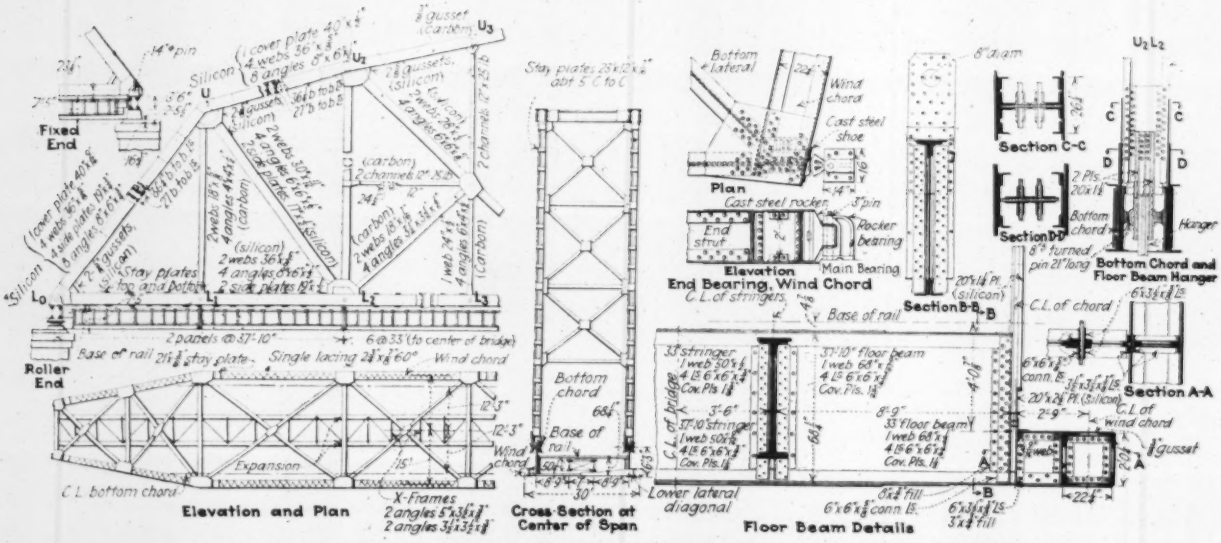


FIG. 4—DETAILS OF THE UNIQUE 547-FT. SPANS, BIG FOUR OHIO RIVER CROSSING
Note cross-section showing separate wind chords and the method of supporting the floorbeams below the bottom chord on pin-connected hangers.

the span complete except the floor system and wind chords. When the new spans were swung, they in turn could be used to carry the old spans while they were being removed. The new and the old trusses were so close together that the new shoes must necessarily occupy the position of the old and they could therefore not be placed until the bearings of the old trusses were out of the way. To provide support for the new spans during this interval and to afford a convenient means of raising or lowering them, the end floorbeams, of box girder section because of the restricted depth, were designed to support the weight of both the old and the new structure, with the jacks or cribbing supporting the floorbeams on 15 ft. centers.

The use of the separate wind chord probably added some weight to the structure, but not so much as might be supposed. Without it, the section of the main chords would have been increased, and with the close spacing of trusses, considerable weight was saved in the top lateral system, sway frames and floorbeams. Its use also permitted swinging the spans at their minimum weight, which was most important. The new spans will undoubtedly look narrow, end on, and after the old structure is gone the reasons for their unusual design will be less obvious, but certain conditions had to be met, and it is felt that the new trusses will function quite as well as those of any other design which might have been adopted had there been no restrictions imposed.

Carbon steel of structural grade was used in the viaducts and in the 207- and 338-ft. spans. In the 547-ft. spans silicon steel was used in the main members of the trusses with the exception of the posts, and carbon steel was used in the floor system, wind chord and bracing. The use of silicon steel in these spans not only was economical but the saving in weight, about 1,000 tons, was most important, as the old spans were loaded to their full capacity during erection. A total of 16,000 tons of steel was used, of which 3,400 tons was silicon steel.

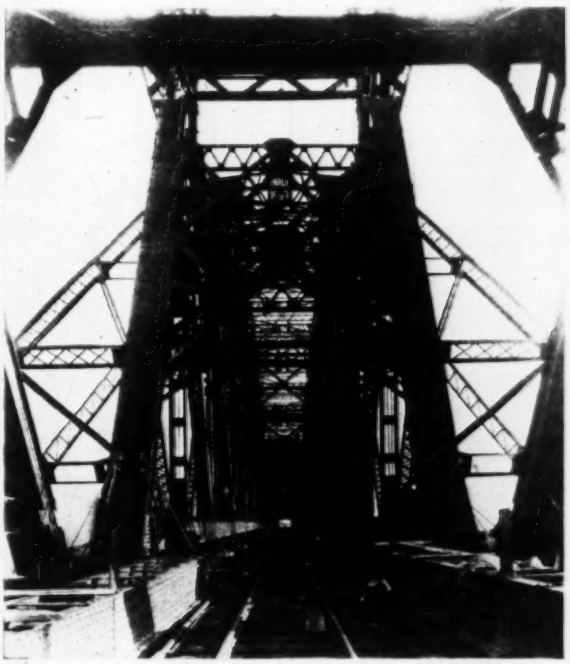


FIG. 5—NEW 547-FT. TRUSS BEING ERECTED WITHIN THE OLD TRUSS
Note kingpost bracing extending outside of old end posts.

Loads and Stresses—The viaducts and the 207-ft. span were designed for E-70 loading and a basic unit stress of 18,000 lb. For the 338-ft. and 547-ft. spans, a loading of E-70 was used for the floor system and web members and E-65 for the chords. For carbon steel, a basic unit stress of 16,000 lb. was used for the live load, 20,000 lb. for dead load. For silicon steel, the corresponding unit stresses were 22,500 and 28,000 lb. After the designs were completed, the spans were investigated for 50 per cent overload, and the section of any member in which the unit stress exceeded 26,000 lb. for carbon steel or 36,000 lb. for silicon steel was increased. Several members were increased, at small expense.

Erection—The three shorter truss spans, being over shallow water, were erected on falsework. For the 547-ft. channel spans, the old bridge structure was utilized as falsework. The weight of each of the new spans without the floor system amounted to about 6,000 lb. per foot, whereas the old spans had been designed for a live load of only 3,000 lb. per foot. Computations showed that with all the expected loads and wind on the old and the new structure the stresses would be well up to the elastic limit, but since the old structure was in excellent condition it was felt that under a static load properly distributed it was not so far beyond safe limits but that adequate reinforcing could be done at a nominal cost. The stress in each member and the theoretical deflection of each panel point under a unit load at any panel point was computed, so that by multiplying the unit deflections by the proper load factor, and summing them, the total theoretical deflection at any or all points could be quickly determined under any condition of loading. It was felt that any considerable deviation of the actual from the computed deflection would give ample warning of overloading throughout or of an unexpected concentration at any point. Checking by deflections proved more positive than by measuring the stresses. As an example, the last pair of top chord sections placed before closing produced an additional deflection of $\frac{1}{2}$ in. at the center, which could be easily checked, while the corresponding increase in chord stress was only 600 lb. per sq.in., which would be difficult to measure. As the applied load approached the maximum, levels were frequently taken, and under no condition of loading did the measured deflection at any point differ from the computed deflection by more than $\frac{1}{4}$ in. The total deflection at the center just before the spans were closed amounted to about 7 in. As a further precaution, the old top chords and end posts were stiffened by the addition of kingpost trusses, bolted in place, and the floorbeams were reinforced to some extent.

The lower chords of the new trusses were set on blocking at the panel points and the load was carried to the floorbeams of the old spans by the stringers. Since the structure was being erected on yielding supports, deflecting progressively, the camber blocking was made of such height that it would be certain that the top chord joints at the center would be slightly open, so that it would be necessary only to raise the ends in order to close and swing the span. The blocking was adjusted from time to time to maintain the true dead-load camber in the bottom chord from the center to each end.

The lower chords and lower half of the diagonals were set with locomotive cranes. The end posts, top chords, upper diagonals and posts were set with a wood

traveler running along the top chord of the old span. These travelers were double ended and so arranged that, in the lifting position, the legs came at the old panel points. Power was supplied by motor-driven hoisting engines set on platforms rigged out from the pier tops, one on each side. A traveler for each span was provided so that work on all three could be carried on simultaneously.

Each half of the lower chord and the lower connections of the diagonals and posts were riveted in their true dead-load position. The center splice and top chord connection were lightly pinned and bolted. After all of the steel was in place four 500-ton hydraulic jacks were set under each end floorbeam, and the span was raised.

The first jacking operation was to close the top chord joint. This required a rise of from 4 to 5 in. and was usually made in three lifts to permit the adjustment of wedges at the quarter points, thus relieving the concentration at the center. After the span was closed it was raised to clear the blocking on the old structure. This required a lift of about 10 in. to take out the deflection of the old spans and to allow for deflection of the new. This left the new spans about 4 ft. above their final elevation, in which position the other joints, except at the top chord center, were made up and riveted. The stringers and upper portion of the floorbeams of the old span were then cut out and the new floor system was placed.

The next operation was to hang the old trusses to the new spans and by means of the jacks to lift them clear of their old bearings, following which the new span, together with the old, was lowered to its final position. The work had reached this stage at the time the accompanying photographs were taken. The lower portion of the old trusses was next removed, the wind chords were erected and finally the remaining portion of the old steel was taken down.

A departure from precedent was involved in placing the deck. It has been frequently observed that the maximum deterioration of girder flanges takes place under the ties rather than between them, and with a creosoted deck the period between renewals is so great that the flanges under the ties can get no beneficial paint protection unless the ties are shifted or temporarily removed. On this long deck it seemed advisable to apply as much paint as possible before the ties were placed, and two layers of 10-oz. duck soaked in red lead and oil were therefore placed in the dap between the tie and the stringer flange, the hope being that the canvas would carry and retain the excess paint and seal the opening. These pads carry about 1 lb. of red lead per tie, and being applied while wet, form themselves over the rivet heads, adhering to the girder rather than to the tie.

Administration—The total cost of the work was approximately $3,250,000. It was carried out under the direction and supervision of C. S. Millard, general manager of the C. C. C. & St. L. Railway Company and general manager and chief engineer of the L. & J. Bridge & Railroad Company. W. S. Burnett was chief engineer of construction, E. A. Humphreys district engineer, and A. A. Keever resident engineer. The plans for the work were prepared in the general office of the Big Four at Cincinnati, L. H. Schaeperklaus, assisted by A. M. Westenhoff, supervising the designing force. The masonry work was done by the Walsh Construction Company, of Davenport, Iowa. The superstructure was fabricated and erected by the McClintic-Marshall Company, Pittsburgh, Pa.

Lloyd Dam in India, the Largest in the World

Forms Major Part of Great Irrigation Scheme Built by the Bombay Presidency as a Protective Work

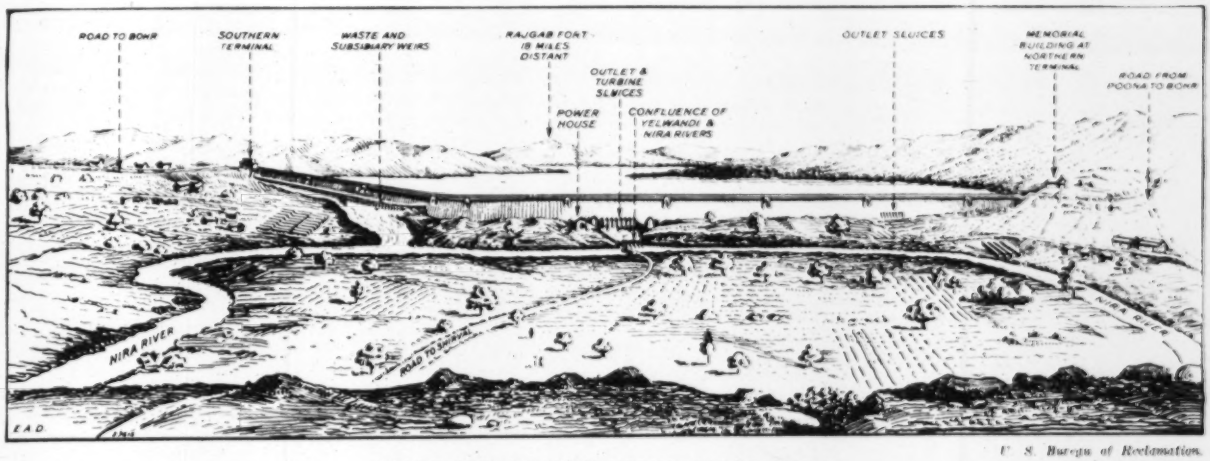
By Reginald Ryves
Consulting Engineer, London, England

LLOYD DAM, at Bhatgar, in the Bombay Deccan, which was officially opened on Oct. 27 of last year, though notable for its large volume, 21,500,000 cu.ft., is really more interesting as a part of one of a series of great projects than as an achievement in construction. The great size of the dam is in nowise the result of an effort to achieve magnitude, nor does it contain a cubic foot of masonry in excess of that needed to provide a reservoir duly related in position, size and cost to the runoff of the catchment area, to the areas which it commands, to the value of the crops to be grown and to those earlier projects in the series of great protective works of which this project is the latest.

The number and magnitude of these protective works may largely be ascribed to the effect produced in the minds of administrations and engineers by the great famine of 1889-1902 and to the recommendations of a commission thereafter convened by Lord Curzon. They were begun in 1903 and include the Wilson dam and Pravara canal project, completed in December, 1926. How effective these works have been and how completely the specter of famine has been laid may be judged, in the first place, by comparing the cost of fighting the famine with the increases in the values of the crops now grown in the irrigated areas. Apart, of course, from the losses inevitably incurred in other respects, the expenditure of the Presidency in combating the effects of the drought was three crores of rupees, or $11,000,000, whereas the total increased value of the crops grown in the irrigated lands is about six crores, or $22,000,000, annually, as the result of a capital expenditure totaling only twelve crores, or $44,000,000.

Features of the Project—The general character of the sites of the dam and reservoir may be realized from the data which follow. The dam had to be 5,333 ft. long and 190 ft. in height above lowest foundations in order to impound water to a depth of 143 ft. over the lowest sluices and to create a reservoir of 24,198 million cubic feet, or 555,555 acre-ft. The site of the reservoir, situated in a catchment area of 128 square miles, is such that this volume of water is impounded in an artificial lake 14½ square miles in area and therefore nearly 60 ft. in average depth. The topography is such that the lake is 17 miles in length and has a perimeter of 46 miles. To regulate the water level in the reservoir there are 81 gates, 45 of which are automatic. Although the hydroelectric power which can be made available as the result of building the dam is about 1,200 hp. this will not be utilized at present.

The two main canals of the Nira canals system, supplied by the reservoir, are 106 and 100 miles in length and the area commanded is 834,000 acres, of which 202,000 acres will be irrigated annually, producing crops of the increased value of $11,900,000. The dam cost $6,300,000 and the whole project $20,700,000. In order to keep pace with the progress and development of the canals, the work



U. S. Bureau of Reclamation.

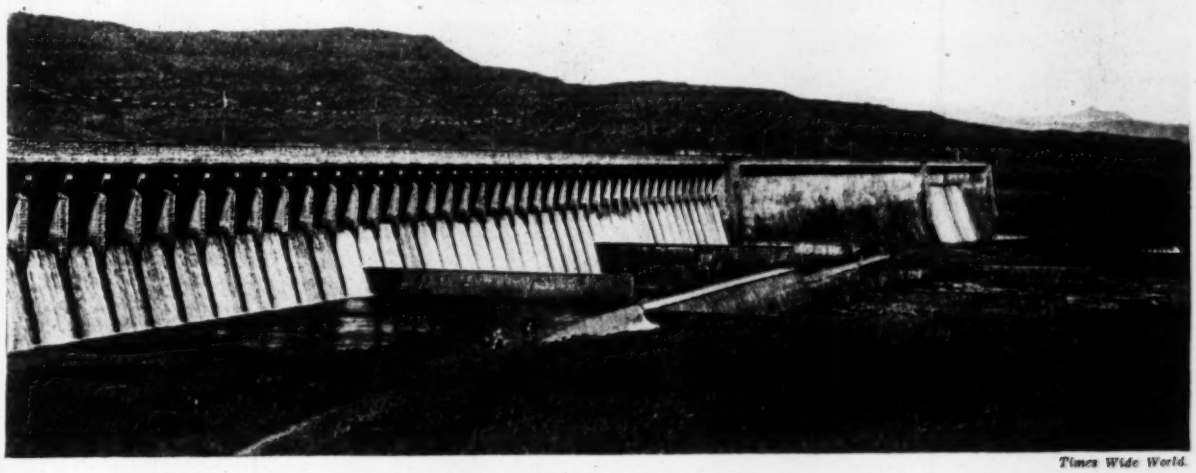
LLOYD DAM NEAR BHATGAR, POONA, INDIA

on the dam was carried on more slowly than would otherwise have been the case, having occupied fifteen years. The dam supersedes the old Bhatgar dam, the crest of which was at a level of 60 ft. below that of the new structure.

Economics of the Project—Although the project is classed as "protective," it will, besides benefiting the populations which it protects—in respect of welfare generally as well as by securing them against famine—yield a direct return of about 3 per cent on the capital expenditure. The cost of the dam is about two-thirds that of the Aswan dam, though it contains about 2,500,000 cu.ft. more masonry than that great barrage. This result must be attributed, in part at least, to the difference between the types, the Aswan dam having a smaller ratio of maximum to average height and no massive middle portion such as reduces the unit cost of masonry. As regards the ratio, for the Lloyd dam, of volume of water stored to volume of masonry, which is 1,140 to 1, this is neither large enough to be a factor tending much to economy in expenditure nor small enough to constitute a handicap in that respect. Similarly, the ratio of cubic feet of water stored to pounds sterling spent on the dam, which is about 18,000 to 1, is not extreme in either sense. The cost of the whole scheme works out at about $103 per acre to be irrigated, representing, at 5 per cent, $5 per acre per annum; which compares with $59, the annual gross value per acre of the crops.

Nature and Values of the Crops—Since information as to the kinds of crops which will be grown on the irrigated lands, their relative importance and their unit values may interest irrigation engineers, the following data are noted. Of the total value of these crops, $11,900,000, no less than $7,200,000 is the value of the sugar cane crop, estimated as 780,000 tons. The other crops are: Grain, 76,000 tons; cotton, 1,890 tons; nuts, 20,900 tons; fruit, 1,100 acres.

Engineering—The engineer mainly responsible for the design and execution of the project, C. B. Pooley, who was the officer in charge of the design of the dam, for ten years afterward was executive engineer in charge of construction and for the past five years was superintending engineer of the Deccan Irrigation Circles, of which this work forms a part.



Times Wide World.

PART OF THE LLOYD DAM IN INDIA

This photograph shows the left-hand end of the dam as shown in the sketch above.

The State's Larger Share in Grade-Crossing Improvement

Disagreement on Cost Apportionment Curbs Grade Separation—Larger Assessment Generally Falls on Railways, but in Many Cases the Capitalized Value of Savings to Highway Traffic Is the Greater Amount

By R. B. Kittredge
Professor of Transportation Engineering
State University of Iowa, Iowa City, Ia.

BOLD ASSERTION is made in this article that the public often enjoys greater financial gain than does the railway through grade-crossing elimination and protection and therefore is under the obligation to contribute more liberally toward their cost. Also the article ventures boldly to indicate that the railway and the highway, under modern conditions of traffic development, appear rather foolish in their traditional rôles of antagonists in crossing rights-of-way privileges and obligations. Plainly the implication is that the time is here when the rights of traffic to unimpeded and safe service is paramount to jealousy of private property rights or to demagogism in public office. This practicality of thought is usually lacking in grade-crossing discussions that it deserves consideration when it offers itself for notice. —EDITOR.

PROGRESS in alleviating the evils presented by highway-railway crossings at grade continues to be hindered by antiquated laws, and perhaps more generally by the lack of agreement among highway and railway officials as to the principles to be observed in making grade-crossing improvements, and particularly by the lack of agreement as to the proper method of dividing the costs. That agreements have been reached resulting in substantial progress in a few states is fortunately true, but such progress is the exception rather than the rule, and in spite of the enormous sums being spent in grade-crossing improvements the hazard continues to increase.

A better informed public opinion on all phases of the grade-crossing problem, resulting in the revision of some existing laws, and a willingness on the part of railway and highway officials to forget the antagonisms of the past and to co-operate sincerely in doing all that can reasonably be done to relieve the acute situation now existing should result in more satisfactory progress.

The fulfillment of dreams for the elimination of all grade crossings must be postponed to the indefinite future, for the cost of such a program would be prohibitive, even if it were physically possible. But with the advent of the motor vehicle and the enormous growth of high-speed traffic on our highways many grade crossings, with their limitations on traffic speed and traffic capacity, have come to represent a real economic loss, and many others, where the loss of time is of no great significance, will represent, while they remain inadequately protected, traffic hazards which cannot long be tolerated.

Programs for relief should include closing many existing crossings which are no longer essential, rigid restriction of new crossings to those special cases where a net public benefit will result, crossing elimination by relocation or by separation of grades where the required expenditure is economically justified and the necessary funds can be made available, the installation of more adequate protection at many of the crossings necessarily remaining at grade and a continuing campaign for safety in operation both on the railways and on the highways.

Benefits and Cost Allocation

Prominent among the obstacles to progress is the lack of agreement as to how the costs shall be proportioned between the railways and the public. The public undoubtedly pays for whatever transportation agencies it chooses to maintain. The public pays as well for whatever grade-crossing improvements are carried out, and this is true regardless of which agency in the first instance foots the bills. The first division of costs is important, however, because charging against each agency of transportation those costs which properly belong to it is in the best interests of the public and because a reasonable division of the costs between the railways and the users of the highways will remove one of the immediate hindrances to progress in carrying out improvements whose justification is clear.

The suggestion that assessments should be made in proportion to the benefits derived meets with more or less general approval, but to express the money equivalents of some of the benefits is extremely difficult. Precise results cannot be expected, but highway and railway officials, working together, should be able to come to substatial agreement on the principal points involved.

Many justifiable elimination projects have been delayed because the law requires or some highway officials insist that the railways should bear an unreasonable share of the costs, and others have been postponed because of the belief of some railway men that they must fight to the bitter end and delay as much as possible every proposed project, regardless of its merits. That some representatives both of the highways and of the railways are already taking a broader view is fortunately true, but too much antagonism remains and too little co-operation.

While in some instances where railway speed restrictions are removed the benefits to the railways from the elimination of a grade crossing are substantial, in many projects the capitalized value of the annual savings to the railway is but a small fraction of the amount it is asked to contribute as its share of the cost of the improvement.

To justify economically the elimination of nearly any grade crossing requires a substantial allowance for the highway-vehicle time saved. Since this is true and since traffic on the highways is increasing rapidly, a number of highway officials have come to agree that a larger proportion of the costs of grade-crossing elimination than has been common in the past should be assessed

against the users of the highways and paid out of the receipts from motor-vehicle fees and gasoline taxes. This position is sound and its general adoption would help speed up grade-crossing elimination, as would a greater willingness on the part of some railway officials to recognize that many of our worst grade crossings must be eliminated and that less antagonism toward those projects economically justified is appropriate.

Co-operative Crossing Protection

Protection of the crossings necessarily remaining at grade presents another problem of substantial magnitude requiring for its reasonable solution co-operation between railway and highway officials, particularly with reference to the standardization of protective devices and the division of costs.

While crossing gates or watchmen, or both, will doubtless be required at some crossings, automatic signals warning the traveler of an approaching train will offer the most satisfactory type of installation at by far the greater number of the crossings requiring more protection than that offered by the standard fixed signs.

The adoption for future installations of one standard type of automatic signal whose warning is instinctively interpreted by automobile drivers as meaning the approach of a train would seem to be reasonably possible and extremely desirable. The adoption of such a standard is being delayed by the failure of railway men to agree among themselves as to the relative advantages of flashing lights and wigwags and the insistence of others on the installation of signals of the traffic type. The sacrifice of individual preferences in the interests of the public benefits resulting from standardized warnings appears to be in order.

To reach an agreement as to the proper division of costs of grade-crossing protection would be to remove another of the immediate obstacles to satisfactory progress. In many jurisdictions the railways are still required to pay the entire cost of whatever protective devices are installed. This is unjust, because the increase in motor-vehicle traffic on the highways is responsible for the increasing need of more elaborate protection, and the payment of a part of the cost of such protection from motor-vehicle fees and gasoline taxes would appear to be fair and would certainly result in a substantial increase in the number of properly protected crossings.

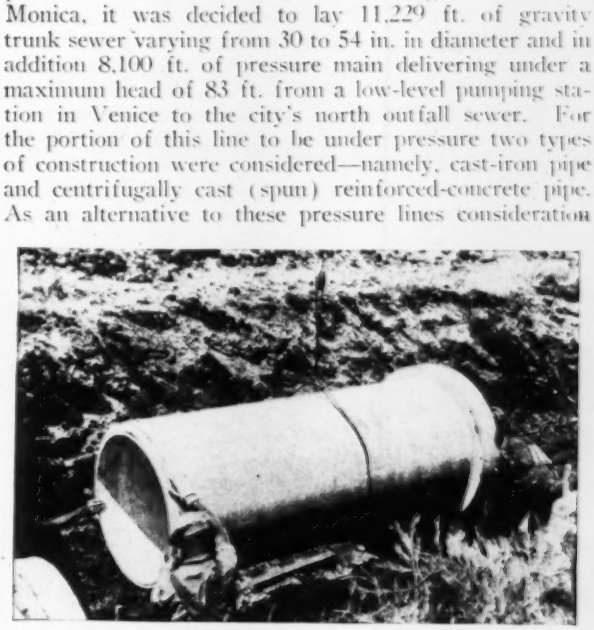
Fatigue Failure of Metals to Be Studied

Test studies to determine the effect of notches on fatigue failures will soon be started by the metallurgical division of the Bureau of Standards. The bureau has been among the first to investigate fatigue of metals and to demonstrate that the cause is not crystallization, as had formerly been supposed. Among the known causes, it is generally realized that sharp notches or re-entrant angles such as keyways, screw threads or even stamped numerals or surface scratches often cause failures in moving parts. Such notches serve as nuclei about which stresses are concentrated to the extent that progressive rupture of the metal occurs with continued motion of the part. In the tests, specimens will be made up of numerous types of steel under different heat treatments. Studies of non-ferrous metals will come later. The effect of different coating and plating methods on fatigue failures also will be considered.

Concrete Sewer Under 83-Ft. Head at Venice, Calif.

Spun Concrete Pipe Cost 20 Per Cent Less Than Cast Iron and Only Half the Cost of a Gravity Concrete Line

IN EXTENDING the Los Angeles sewer system to serve the needs of newly annexed territory in Venice and to provide an outlet for the sewage of Santa Monica, pursuant to a contract between Los Angeles and Santa Monica, it was decided to lay 11,229 ft. of gravity trunk sewer varying from 30 to 54 in. in diameter and in addition 8,100 ft. of pressure main delivering under a maximum head of 83 ft. from a low-level pumping station in Venice to the city's north outfall sewer. For the portion of this line to be under pressure two types of construction were considered—namely, cast-iron pipe and centrifugally cast (spun) reinforced-concrete pipe. As an alternative to these pressure lines consideration



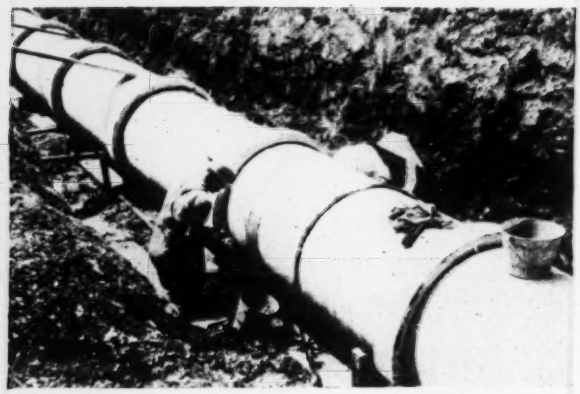
LOWERING AN 8-FT. SPUN PIPE SECTION INTO THE TRENCH

A spun collar, calked to one end of each section in the casting yard, forms the bell end.

was also given to the possible use of a deep, reinforced-concrete gravity line 8,100 ft. long. If this alternative had been adopted, it would have been necessary to put the pumping station at the lower end of the line near the north outfall sewer.

The bids for these three types of construction were as follows: (1) pressure main using cast-iron pipe $131,853; (2) pressure main using spun concrete pipe, $104,407, and (3) gravity sewer using tamped concrete pipe with tile liners, $208,746. (These costs are exclusive of the gravity sewer work.) The spun pipe line therefore was built and although when this article was written the line was not yet in service due to delay in completing the pumping station, it has been completed and has passed all specified tests by a wide margin.

The reasons for the wide differences in the costs given were that a gravity grade would have required much heavier excavation and a pipe diameter of 54 in. as compared with 36 in. for a pressure line. Economies of operation also required that a gravity line be built with a gradient suitable for its ultimate capacity (in this case 30 sec.-ft.), regardless of initial low flows. Moreover, because of the danger that an unfilled concrete pipe might suffer disintegration from sewer gases, it was considered necessary to specify tile liners in a gravity concrete pipe which for a long time would flow only partly full.



CALKING JOINTS WITH GROUT-IMPREGNATED HEMP
Pipe is shown on the concrete base before the side supports were poured.

The cast-iron pipe could have been laid under the requirements governing the pressure main, which called for a diameter of 36 in., but the pipe itself in this case involved a much higher cost than did spun pipe.

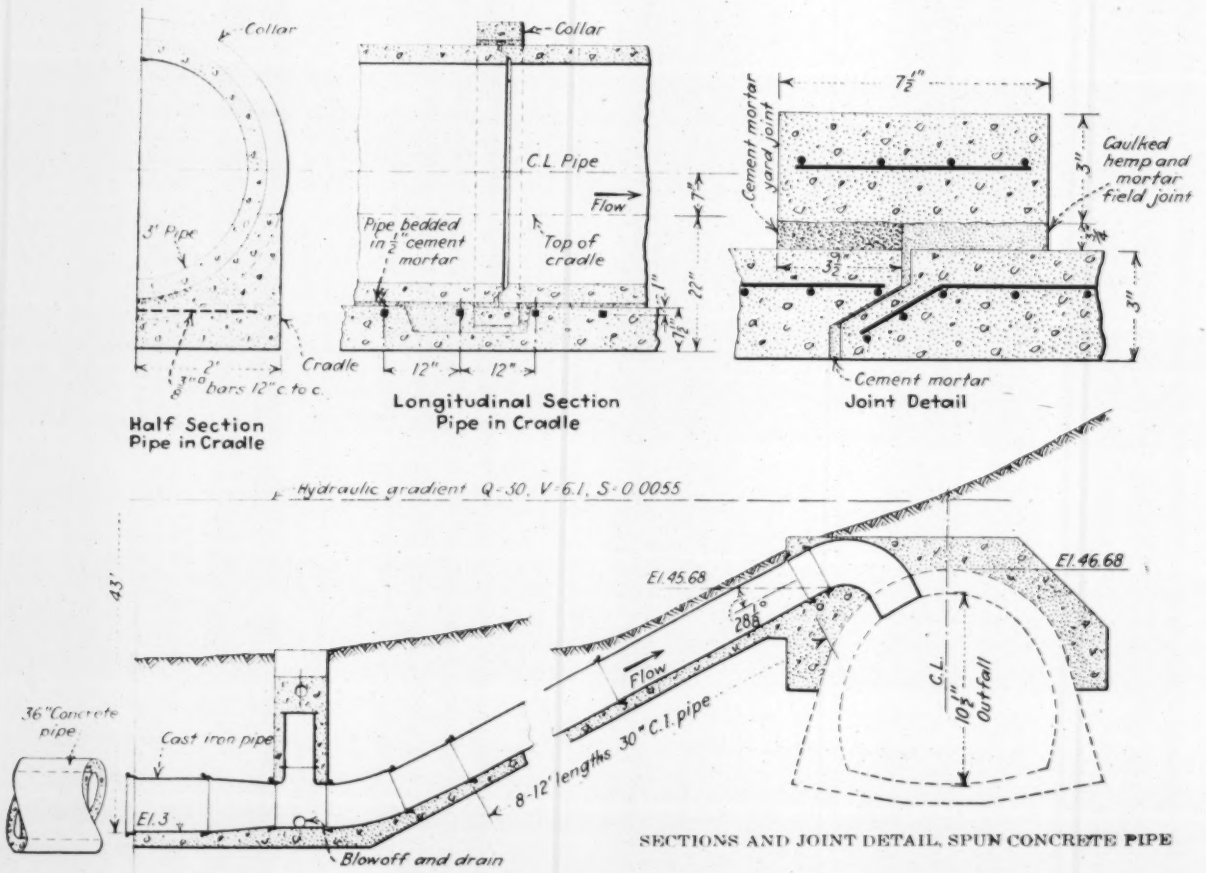
The 36-in. spun concrete pipe was given a preliminary test before the contract was awarded. In these tests, pipe specimens withstood an internal pressure in excess of the specified requirement of 45 lb. per sq.in. and an external loading also in excess of the service loads imposed by the backfill.

The method of testing spun-pipe sections at the casting yard as they were built for the Venice job consisted in selecting two sections at random from each lot of 25 and subjecting these to a hydrostatic pressure of 45 lb. per sq.in. In the event that as many as three sections in any lot of 25 failed to meet specifications, the contract required that every section be individually tested. All of the tests, however, both of the specimens and of the line as a whole when subjected to final field test, were successful.

The specifications required that a field test of the completed line be made with the open ends bulkheaded so the line could be filled with water and allowed to stand for four days. Thereafter a four-hour continuous test was to be run with an internal pressure amounting to 125 per cent of the 36 lb. per sq.in. which is the maximum service pressure to be put on the pipe. Under this test the total leakage was not to exceed 200 gal. per inch of diameter of pipe per mile per 24 hours, the leakage being measured by metering the water pumped into the pipe to maintain the required pressure.

In testing the completed line the over-all length subjected to pressure was 8,100 ft. and included, in addition to the 36-in. spun concrete pipe, two sections of 30-in. cast-iron pipe, one 675 ft. long where a siphon was used and another exceeding 100 ft. in length at the terminal discharge lift.

The pressure was brought up to 45 lb. per sq.in. and held there for a period of four hours. Leakage at the end of the first hour amounted to 11 cu.ft. and continued at approximately the same rate for the remainder of the test period, the totals being 23 cu.ft. at the end of the second hour, 34 at the end of the third hour and 45 at the end of the fourth hour. Of this total leakage a considerable amount (estimated as one-quarter to one-half) occurred around the upper bulkhead. The total



SECTIONS AND JOINT DETAIL, SPUN CONCRETE PIPE

leakage for the entire line amounted to only 20 per cent of the leakage allowable under the specifications.

The spun pipe was made of a 1:1:2 mix with no aggregates larger than ⅜ in. The specifications called for a minimum crushing strength of 24,000 lb. per 4-ft. length of 36-in. pipe. All lengths tested satisfactorily and withstood a load of 33,000 lb. On a single special test in which the load was increased to 50,000 lb. a narrow crack developed at 48,000 lb., but complete failure had not occurred at 50,000 lb. and the machine was unable to develop a greater load. For crushing tests a

EXCAVATING TRENCH AND PLACING PIPE SECTIONS
Construction across low lands required continual pumping to keep trench unwatered.

wood cradle similar to the concrete cradles built on the job were used, thus distributing the load over an arc of 90 deg.

Much of the territory traversed by this sewer is swampland or tide flats in which the bottom is very soft. It was therefore decided to support the pipe on a continuous concrete cradle of the design shown in the accompanying illustration.

This base was reinforced transversely to prevent cracking; and depressions for the pipe bells were left every 8 ft. to facilitate making joints between sections. The joints were calked tight with strands of hemp impregnated with thin cement grout. It was required that the joints should be calked before pouring that portion of the concrete cradle that extended above the base itself.

A novel feature in the design of this sewer is a location such that most of the actual lift, amounting to about 45 ft., occurs in the 100-ft. length of the line immediately preceding the discharge into the city's outfall sewer. Thus, in the event that it becomes necessary to take the pressure head off the line for any reason, this can be done by draining only 100 ft. of the line. A 6-in. blowoff is provided at the low point in the line for drainage purposes.

The pipe was fabricated and its laying supervised by the Bent Concrete Pipe Company (now the American Concrete Pipe Company), of Los Angeles. The project was under the general supervision of John C. Shaw, city engineer of Los Angeles. W. H. Pinkham was engineer of sewers in charge of design and F. A. Batty was construction engineer. The contractors were R. A. Watson and the firm of Dimmitt & Taylor, of Los Angeles.

An Aluminum Transit With a 50-Year Record

SUCCESSFUL service for more than half a century is the record behind an aluminum transit recently acquired from Walter Washabaugh, a civil engineer of Charlottesville, Va., for the museum of W. & L. E. Gurley, Troy, N. Y., the company that built the instrument in 1876 for exhibition at the Centennial Exposition in Philadelphia. Research among the records of the Gurley company developed the fact that tubing for the instrument was brought from Paris, this fact being recorded in William Gurley's handwriting.

E. W. Adams, chief engineer of the company, describes the transit as follows:

"The aluminum transit was finished in the natural color and lacquered with shellac, baked on. Of the problems, the most

ALUMINUM TRANSIT THAT HAS BEEN IN USE 50 YEARS

puzzling was to veneer the silver on the surface of the limb. It was accomplished by screwing in brass plugs staggered over the surface about 2 in. apart. These were faced off and a ring of thin brass soldered to them, then the silver was soldered to the brass surface with a lower fusion solder and finished in the usual manner. Where surfaces were subject to friction, they were bushed by shrinking on and pinning brass or bronze. The centers or sockets were of standard stock.

After 53 years of service the interior of the graduated compass circle, which is covered with glass, is about as fresh as when first finished. The exposed parts are slightly pitted. One of the standards has been replaced by a brass one and plated. Otherwise there has been no change, and the instrument, now in the museum of its makers, is in good serviceable condition.

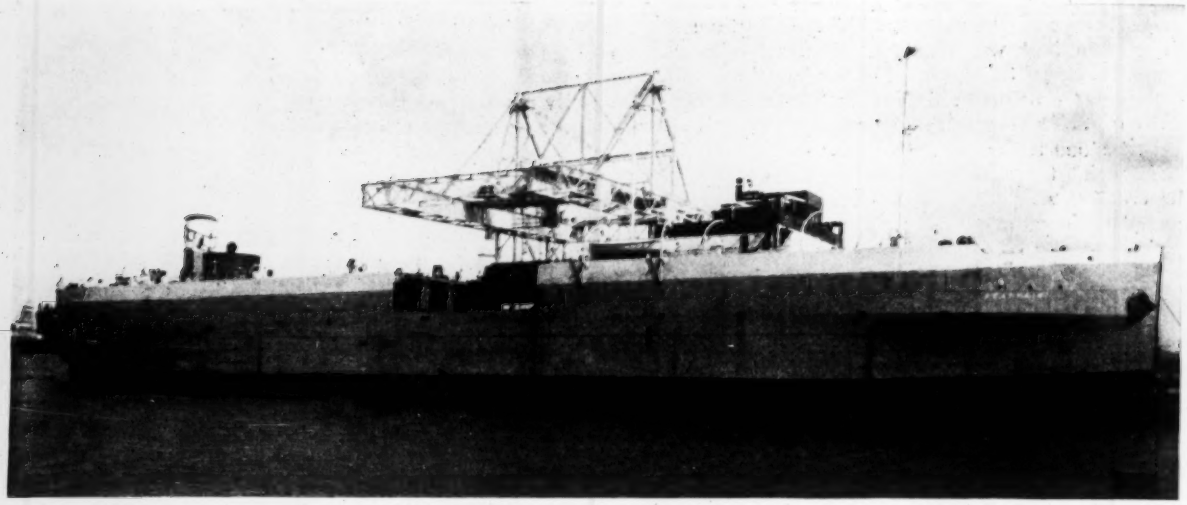


Fig. 1—Crane Lifting Freight Car Aboard the "Seatrain" at New Orleans

Unique Crane Loads Freight Cars on Ship for Ocean Transport

New Method in Freight Transfer Between New Orleans and Havana—Novel Ship Equipped With Four Track Decks—Design of Structural Steel Loading Crane

By Joseph O. May
Assistant Engineer, American Bridge Company, New York City

FREIGHT-CAR service between New Orleans and Havana, under the ownership and management of the Over-Seas Railways, Inc., was inaugurated on Jan. 12, 1929, by the "Seatrain," the first vessel ever built to carry freight cars on more than one deck. Interesting structural problems were involved both in the vessel itself and in the large crane constructed at each terminal for handling the freight cars between tracks on the wharf and the hold of the ship. The crane at the New Orleans terminal is shown transferring a freight car to the vessel in Fig. 1.

The "Seatrain" itself is a 10,500-ton vessel, 427 ft. long, capable of transporting 90 to 95 freight cars loaded with about 65 tons each. There are storage tracks for four cars abreast on the main deck, on the 'tween deck and in the hold; there are also four tracks on the aft portion of the superstructure deck, where the cars must of course stand out in the weather. Four hatches are provided, one for each track, and cradles, in which the cars are hoisted, are supplied for each of the hatches on the main and 'tween decks, and for each of the four positions on the tank top in the hold.

Briefly, the loading procedure is as follows: By means of a switching engine a loaded freight car is spotted on a "cradle" set into a pit in the dock beneath the crane boom. The car is locked in position, the crane lifts the cradle with its car, the overhead trolley carries it to a position over the hatch to be served, and the cradle is lowered to its seat at the deck for which the car is intended. The car is released and drawn off by a mechanical device operated by the ship's own steam-driven winches. Whenever possible, another car intended for discharge is rolled onto the cradle from the opposite direction, and the procedure is reversed.

The transportation of goods in a freight-car ship is designed to reduce both the manual labor and the time consumed at the steamship terminals. It is also claimed that less damage and delay due to bad weather occurs and that there is less need for the crating and packing of goods. It has already been demonstrated that the "Seatrain" can discharge and reload a complete cargo of freight cars in one working day with a small number of men and that it can maintain a regularly scheduled round trip each week.

The loading cranes are the items of chief structural interest; also, because of their location on the wharves, the foundations are somewhat unusual. As shown by Fig. 5, each crane comprises a framework of four tower legs supporting the crane rail girders, which extend out over the hold of the ship. The outer end of the crane rail girders are part of a hinged boom which is pulled up to permit the ship to dock. Because of the large loads handled—loaded freight cars and the crane boom itself—the hoisting machinery is also unusual.

Substructure—The New Orleans crane is actually located several miles below that city at Belle Chasse, La., on the Mississippi River. To obtain sufficient depth of water for the "Seatrain" the new wharf is located about 230 ft. beyond the center line of the present levee and is reached from either end by a single-track timber trestle widened for two tracks near the crane.

The substructure for the front crane legs required

138 vertical piles and 24 batter piles, the former driven to an average penetration of 65 ft. below low water. The piles are capped by a reinforced-concrete slab 4½ ft. thick. In order to distribute the load over the front piles, the slab is surmounted by double girders, 7 ft. deep and 90 ft. long, which take the direct bearing of the front crane legs.

Each rear crane leg rests on a reinforced-concrete block 18 ft. square and 11 ft. deep, supported by 49 vertical piles and twelve batter piles. The foundation under the front legs and the two foundations under the rear legs are separate units tied together at the top by means of steel girders and bracing.

At Havana the crane is located on an extension of an existing wharf. The prevalence of the teredo in the waters of Havana harbor necessitated the use of reinforced-concrete piles, except for the dolphins and fenders. A total of 80 vertical piles and 28 batter piles, 18 and 20 in. square, was driven. The substructure for this crane is made up as a unit, with a concrete slab extending over the entire base. Under each of the main legs the slab is 6 ft. thick, reducing to 6 in. between the longitudinal and transverse reinforced-concrete girders.

Crane Structure—Details of the crane structure are shown by Fig. 5. The four main legs or towers, each 9½ ft. wide, are spaced 57 ft. in the clear, lengthwise of the wharf, and 35 ft. c. to c. at right angles to the wharf, the latter being sufficient to accommodate two lines of railroad track. Each leg is composed of two 14-in. wide flanged column sections, with the necessary bracing. The crane rails are carried on the upper flanges of the main girders at a height of 60 ft. from the base. These girders are 7 ft. deep and are supported on brackets 15 in. inside of the inner columns, making the distance center to center of crane rails 54½ ft. The outer flanges of the outer columns of the tower legs are connected at the level of the main girders by means of auxiliary lattice girders 7 ft. deep, braced to the main crane rail girders by top and bottom lateral systems.

Each backstay, connecting the tops of the inner columns front and rear, consists of a flanged section 14 in. wide. A complete system of two-plane bracing connects the inner front columns to the backstays and rear columns. Two-plane bracing is also provided in the inclined plane of the backstays between the main rear legs and between the front legs. The latter bracing is discontinued 6 ft. 7 in. above the crane rail, in order to clear the trolley which passes back and forth along the crane runway.

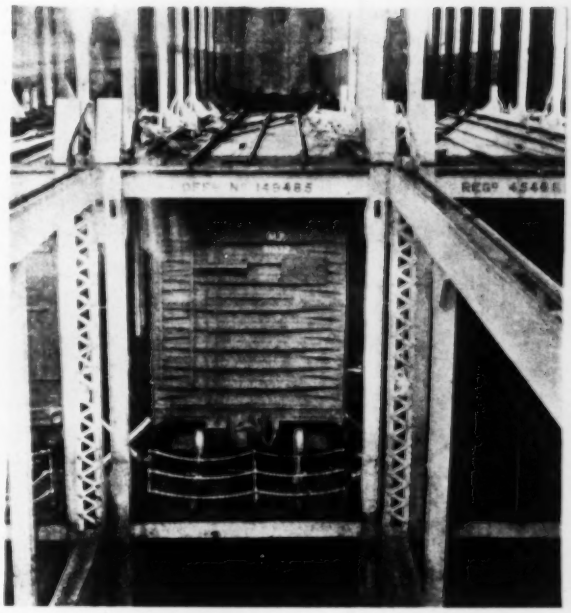


FIG. 3—FREIGHT CAR ON BOARD "SEATRAIN"
View taken from hatch, showing car on 'tween deck and method of anchoring cars, consisting of rail clamps and side jacks resting against the special jacking rails.

The Overhanging Boom—The horizontal projecting portion of the structure, usually referred to as the boom, is hinged near the front columns so that it can be raised to a nearly vertical position in order to clear the masts and deckhouses of the ship while it is being docked. Construction of the boom is similar to that of the fixed portion of the structure, consisting of main girders 54½ ft. c. to c., and lattice girders 10 ft. 9 in. outside of the main girders, all lined up with the similar members of the fixed structure. The outer ends of these pairs of main and auxiliary girders are joined by lattice girders 7 ft. deep and 7 ft. c. to c., having top and bottom laterals between them.

Each of the hangers supporting the boom in its working position is made up of an eyebar chain of one short link and two long ones. The short link is at the lower end and has a pin connection to a sloping diaphragm between the main and auxiliary boom girders. Each hanger is divided into two separate groups of eyebars and pins, so arranged that

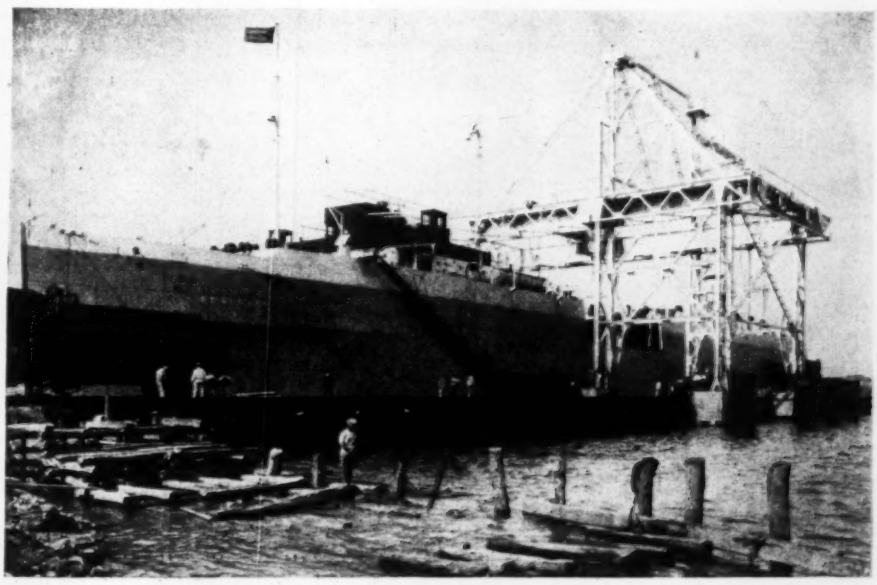


FIG. 2—CRANE AND "SEATRAIN" AT HAVANA WHARF

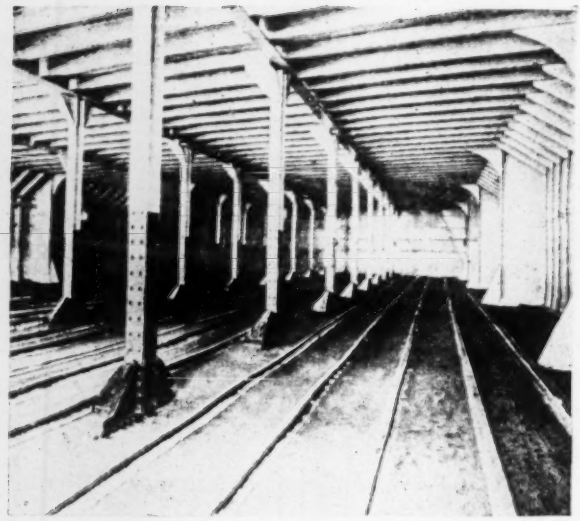


FIG. 4—TRACKS ON MAIN DECK OF FREIGHT-CAR SHIP

Center rail is part of pulling equipment. Outer rails serve as reaction girders for jacks, which hold cars in position.

the boom hoist block and ropes come between them. As the boom is hoisted, the long eyebar links pivot about their pins and fold downward out of the way, while the short link remains in practically the same relative position.

The lower boom hoist block contains two sheaves and its side plates are extended to engage the same pin that connects the short link to the sloping diaphragm. The upper boom hoist block at the top of the tower contains three sheaves. This block is not connected to the top gusset plates through the sheave pin, but the side plates are elongated to engage a pin which forms a pivot about which the entire block can be swung for the removal of the sheaves.

To make proper provision for the forces which vary in intensity and direction as the trolley moves along the boom, the structure at the boom hinge is stiffened by means of horizontal and vertical diaphragms. The hinge bearings are steel castings, four sets to each crane. Each bearing on the boom is made so that it can transmit downward stress directly to a seat on its fixed bearings, all stresses in other directions being transmitted through the 6-in. hinge pin. To obtain this result, unusual shop accuracy was required. Each set of girders, diaphragms and hinge bearings was completely assembled at the shop and the holes for the hinge pins were bored while the boom castings were resting firmly on the fixed bearings.

When the boom reaches the top of its swing it is necessary to lock it in that position by means of a hook 5 ft. long projecting horizontally from the inner columns on each side of the crane. As the limit of travel is reached, each hook automatically engages an anchorage pin attached to the boom. A certain degree of flexibility is obtained by means of a coiled spring inside the barrel of each hook. When the boom is to be lowered, the

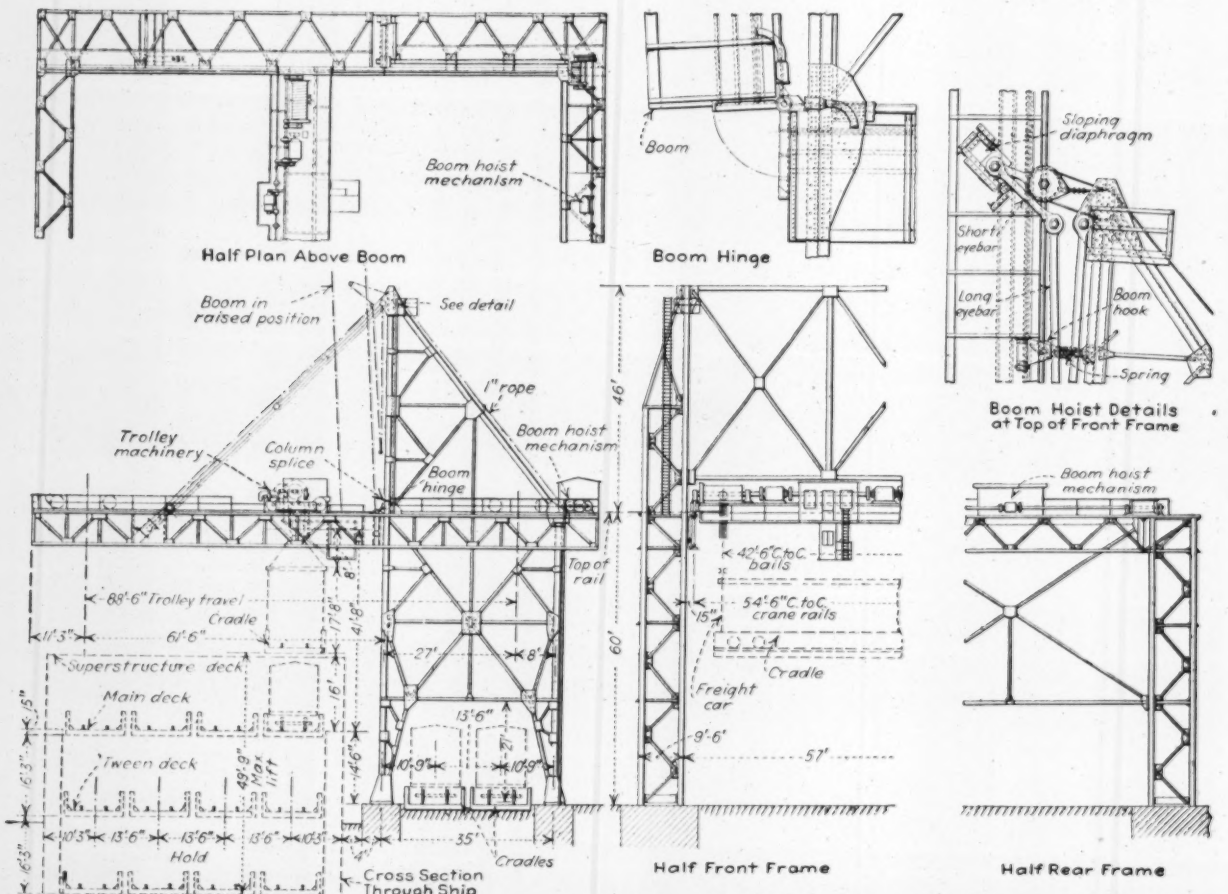


FIG. 5—DETAILS OF FREIGHT-CAR HANDLING CRANE

Note relative position of ship and the arrangement of its decks.

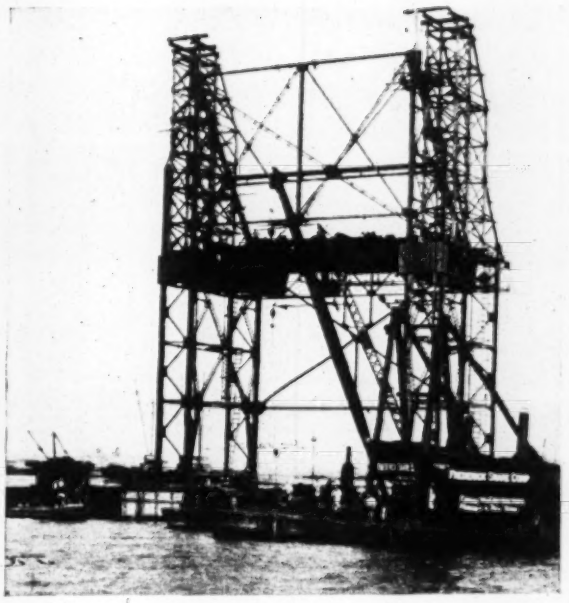


FIG. 6—HAVANA CRANE UNDER CONSTRUCTION
Note the timber tower falsework used to erect the top structure steel.

hooks are disengaged by means of vertical rods and levers operated from the base of each front leg.

Design Loads—The crane was designed to lift a load of 105 tons, made up of a 15-ton cradle and a 90-ton loaded freight car. The trolley with its machinery weighs 60 tons, and the maximum stress occurs in many members of the structure when the loaded trolley is at the extreme outshore position on the boom. Under such a loading the maximum reaction at the front footings is 790,000 lb. and the maximum uplift at the rear footings 360,000 lb. for each leg, including 25 per cent of the live stress as an allowance for impact.

Both cranes are located in the hurricane area and special provisions were made to guard against damage by high winds. A wind pressure of 72 lb. per sq.ft. was assumed, corresponding to a wind velocity of about 150 miles per hour, this to be applied to the structure with the boom either lowered or raised, but without live load. The steelwork and masonry were designed to resist the bending moments and uplifts developed at the front footings by a transverse wind. A unit stress of 24,000 lb. per sq.in. was used for the stresses due to the 72-lb. wind load when combined with dead load. Each of the four tower legs is anchored by means of four $3\frac{3}{4}$-in. forged bolts.

Cradles and Hanging Bails—A cradle is supplied for each of the hatches on the main and 'tween decks, and for each of four positions on the tank top in the hold. Each cradle is essentially a through-plate girder span $45\frac{1}{2}$ ft. long, with five panels of stringers and floorbeams. The main girders are 4 ft. deep and 11 ft. $5\frac{1}{2}$ in. c. to c. Near each end of each girder there is a pin-coupling device for easy and rapid attachment to the bail hangers. For the 'tween deck and hold the cradles are made interchangeable, but each main deck cradle is made to fit its own hatch and when set in position becomes a watertight cover.

Since the aft portion of the superstructure deck is also equipped with four lines of track for the storage of cars, one additional cradle is provided to fit any of the four positions at the break of the deck. This cradle is $55\frac{1}{2}$ ft. long and accommodates longer cars than the twelve other cradles. It remains unloaded, serving as a gangway between the two sections of this deck, while the other cradles carry loaded freight cars while the ship is in transit.

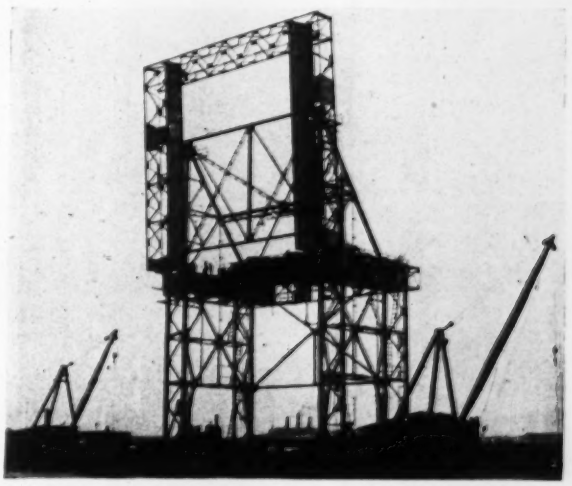
For picking up the cradles, there are two hanging bails, one suspended from each main hoist block. The cheek plates of each block are extended for the attachment of two pairs of 3-in. eyebars forming the sides of a triangle of which the base is a latticed channel strut. From the lower corners of this triangle two pairs of 3-in. eyebars are suspended, each pair supporting a $2\frac{5}{8}$-in. diameter rod having an elongated hole in its lower swaged end to engage the coupling pin attached to the end of the cradle girder. This rod is so made that a man can lift it, if necessary, to assist in the coupling operation.

Machinery—There are three principal sets of machinery—trolley travel, main hoisting and boom hoisting. The first two are located on the trolley itself and are operated by master controllers placed in a cage beneath the trolley. The cage is so constructed that the operator can see clearly on all sides and below. The wiring is arranged so that the crane can also be operated from the main deck of the ship. For this purpose duplicate master controllers for the main hoist and trolley travel are located at each of the four hatches on the main deck. A nineteen-wire flexible cable from these controllers communicates with the control panels on the trolley.

The moving trolley consists of a pair of girders with transverse truck beams at each end equipped with track wheels, and carries its own electric motor driving mechanism and a motor-driven hoisting mechanism, as shown by Fig. 9.

A full-load trolley speed of 200 ft. per minute is obtained by one 75-hp. motor operating at 420 r.p.m., located at the center of the trolley span. This motor, through a spur gear reduction, drives a shaft extending the whole length of the trolley, and this in turn drives one track wheel at each end through a second gear reduction. Spring bumpers are provided at the extremes of trolley travel, and the shore end bumpers are equipped with hooks for anchoring the trolley when not in use.

The main hoisting machinery consists of two equal



'G. 7—HAVANA CRANE WITH BOOM IN RAISED POSITION

units, spaced 42½ ft. c. to c. so as to lift the cradle from both ends. Each unit consists of a motor with two reductions of spur gearing and a drum with right and left hand grooving for 1¼-in. wire ropes, as shown by Fig. 9. These ropes are reeved in an eight-part block, winding two parts, so that the total load is lifted on sixteen parts of rope, winding four parts. The motors are series wound, 250 hp. at 400 r.p.m. With the 105-ton load, the total of 500 hp. gives a hoisting speed of 50 ft. per minute. The two sets of gearing are connected by an equalizing shaft extending from one to the other, so that both drums will maintain the same speed and the cradle will always be level.

To take care of the slack cable as the trolley travels back and forth, a cable drum is geared to one of the trolley trailing track wheels, revolving at the same peripheral speed and in the same direction. One end of the cable is clamped to the drum and the other end is anchored to the back of the crane. To prevent the cable from sagging, it is laid in a trough running the full length of the trolley runway, a few inches below the drum. This trough is skewed at the same angle as the coils on the cable drum and thus serves also as a guide for coiling the cable evenly on the drum.

The machinery for raising the boom is at the rear of the platform at the level of the trolley track. The single motor, located at the center of the platform, develops 40 hp. at 435 r.p.m. and drives a long shaft through a single spur gear reduction. The control stand is near the motor and consists of a drum-type controller with four resistance units, all inclosed in a weatherproof cabinet. The greatest strain on the mechanism occurs when the boom is beginning to rise. The hoisting speed is then about 6 ft. per minute and is accelerated to nearly twice that speed as the boom approaches its highest position. The control is arranged for dynamic lowering, and as the boom is lowered to its working position, a limit switch prevents winding the ropes backward on the drums.

Builders of the Crane—The original design for lifting freight cars aboard ship, prepared by Henry Goldmark, consulting engineer, with the assistance of the author, provided for the entire handling apparatus on board the vessel. This scheme was eventually abandoned, but the general features of the design relating to the cradles and bail were retained. The design of the crane superstructure and machinery, as built, was made by G. E. Moore, consulting engineer, crane department, Manning, Maxwell & Moore, Inc. Both cranes were manufactured at the Shaw Crane Works of Manning, Maxwell & Moore, Inc., at Muskegon, Mich.

The erection of the cranes was performed by the Frederick Snare Corporation, of New York City, which also designed and built the foundations at both terminals. Graham M. Brush is president of Over-Seas Railways, Inc.

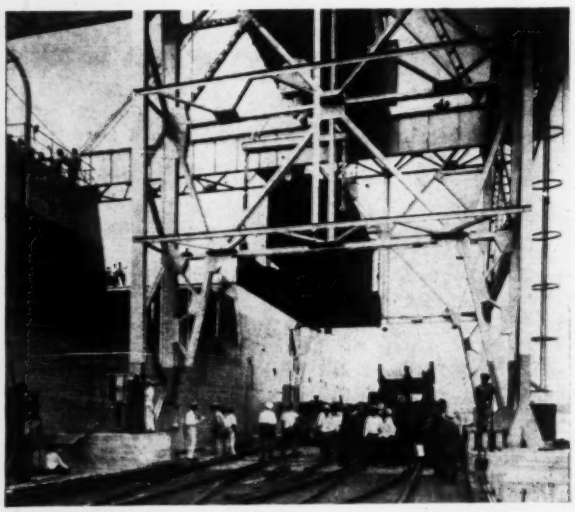


FIG. 8—LOADING A FREIGHT CAR AT HAVANA
Note through-plate girder cradle and balls for lifting.

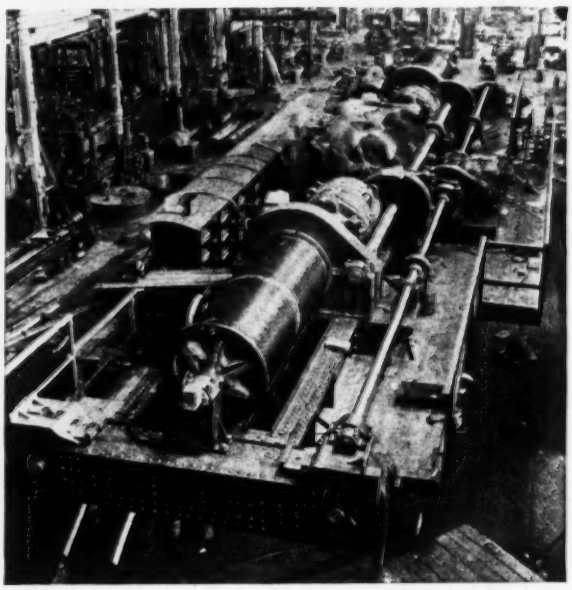


FIG. 9—TROLLEY MACHINERY ASSEMBLED IN SHOP
Grooved drum in foreground for main hoisting; similar drum at opposite end. Long shaft for trolley travel operated by motor at center.

Tests Prove That Concrete Incasement Adds to Column Strength

That the concrete casing of steel tower columns in the Hudson River bridge now under construction between Fort Lee and Fort Washington will add materially to the strength of these members has been established by the tests now nearing completion at the Bureau of Standards in co-operation with the Port of New York Authority. Before these experiments it was not certain whether this would be the case or whether the members would have to carry the concrete as an added burden. To determine the effect of the concrete, model columns were made on a ratio of 1:4.5 as to areas, using carbon, silicon and manganese steels.

Tests of incased columns were made on carbon steel only, since concrete incased silicon and nickel steel columns would have exceeded the capacity of the vertical testing machines and would have made testing to destruction impossible. The difference between the ultimate strength of the carbon columns incased and unincased was taken as indicating the additional bearing capacity given by the concrete. It was assumed that the same increase in strength would result from incasing the other columns. For the carbon steel, the incased columns broke at a load 40 per cent higher than that of the unincased. This would mean a gain of about 30 per cent for the silicon steel members to be used in the bridge.

Experience With Concrete Ties on European Railways

Composite Type With Two Blocks and Steel Bar Gives Good Results—Various Ties and Rail Fastenings

EXTENDED trials of reinforced-concrete ties of various designs on European railways have given satisfactory results in some cases, though the service has been for a few years only, but on the other hand there have been total failures within a few months. These results are shown in a paper by D. I. de Veali in the *Bulletin* of the International Railway Congress for February, 1929. He divides the designs into three classes: (1) ties designed as beams and capable of resisting bending moments both at the middle and under the rails; (2) ties with the section greatly reduced at the middle and therefore incapable of resisting bending moments at that point; (3) ties composed of a pair of blocks resisting bending moments under the rails and having a more or less flexible connection, together with a reduction of the bending moment at the middle. Ties of the first two classes are made of reinforced concrete only; those of the third class combine reinforced-concrete blocks with iron or steel connecting bars. The main conclusion presented is in favor of this last type, as shown by the following quotation:

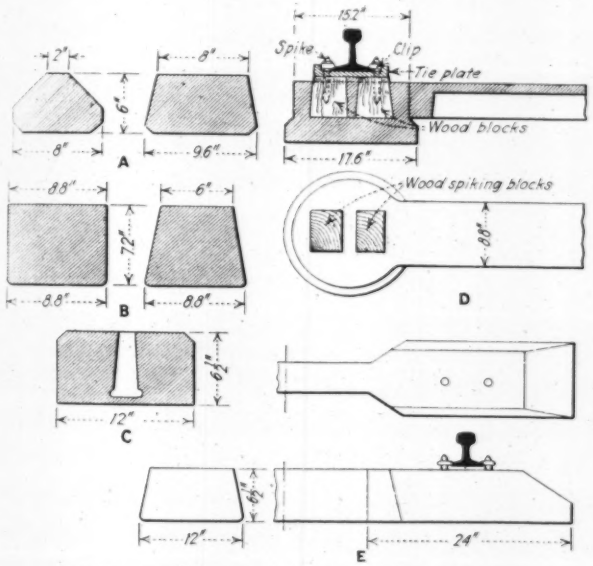


FIG. 1—TYPES OF FOREIGN CONCRETE TIES
A, Italian State Railways. *B*, Swedish State Railways. *C*, Paris-Orleans Railway. *D*, Italian State Railways. *E*, Vagneux tie, France.

> The concrete tie formed as a beam or girder of more or less constant section and with reinforcing bars extending throughout its length has given as a rule bad results. Apart from crumbling or cracking, due to imperfect rail fastenings, more or less serious cracks or fractures have developed at the center and underneath the rails. The cracks at the center were more frequent and more serious in the short ties and always had the appearance of cracks due to insufficient resistance of the ties to the bending moments at the center. The cracks under the rails were more frequent and serious on the bottom surface (negative bending moment) of the longer ties, due to insufficient resisting power, although they were frequently confused with cracks caused by the system of rail fastening. Leaving the fastening out of the question, the only way to obtain a tie of this type which will stand the stresses consists in suitably increasing the cross-section and the reinforcement, to the great detriment, it must be admitted, of the economical aspect. The Calot tie, noted later, has been designed on these lines.
>
> Concrete ties composed of two blocks joined together by a concrete beam of small section have given bad results by breakage at the center. That is to say, the reduction of the bending moments at the center, due to the reaction at the center being diminished, is not sufficient to justify the reduction of the section opposing these moments, since the tie continues to function as a rigid beam. The composite tie of steel and concrete has given probably the best practical results and, when well designed, will serve the problem definitely.

Drawbacks to the concrete tie, as noted by Mr. de Veali, are its considerable weight and its brittleness or relative weakness. But he considers that such ties should never be hauled great distances, as they can be made usually near the place where they are to be laid, while the increased cost of laying will be slight when the longer life of the tie is taken into account. He states that he has seen the laying of thousands of concrete ties, but rarely have ties been rejected for defects due to transportation or handling. However, care must be taken in tamping the ballast so as not to break away the corners of the ties. For the ballasting, a bed of fine material under the tie is desirable to give a uniform distribution of the load. As the rigidity of track on concrete ties results in greater noise of trains and affects the rail fastenings, it is usual to place some kind of elastic packing between the rail or tie-plate and the tie. For this purpose the most satisfactory material is said to be wood compacted under heavy pressure.

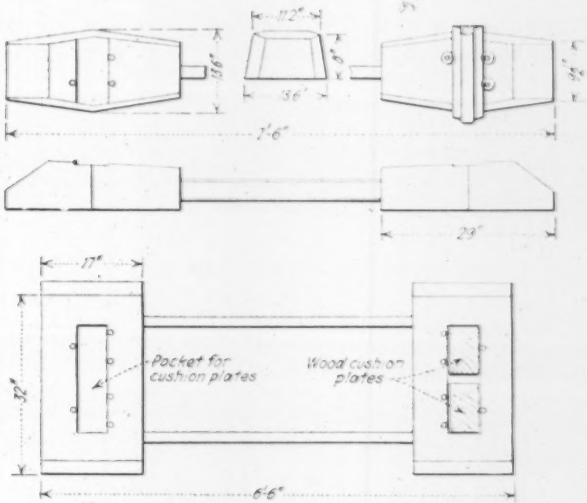


FIG. 2—VAGNEUX COMPOSITE TIE
Above—Design used on a French railways. Below—Double tie for rail joints.

In regard to ties of the first or beam type, noted above, one of the earliest was that shown at *A*, Fig. 1, which was tried by the Italian State Railways on a large scale but with total failure. It was 8 ft. 6½ in. long, approximately rectangular in section at the rail seats and triangular at the middle. Although 300,000 of these ties were laid in 1908, nearly all had to be removed in a few years. A modified type, *B*, was used on the Swedish State Railways in 1917, but in a few months they had started to crack badly under the rails and at the middle, so that in about a year they were all removed. These ties were 8 ft. 10½ in. long. A more successful design was the Calot tie, *C*, now a standard feature in track construction on the Paris & Orleans Railway, which has

separate designs for main lines and secondary lines. But it is of much larger section than the others and its volume is nearly double that of the design at *A*, although its length is only 7 ft. 10½ in. Thus the cross-section at the rails is 45, 61.4 and 74.4 sq.in. for designs *A*, *B* and *C*, respectively. At the middle, the section is 31, 52.7 and 74.4 sq.in., respectively.

Among ties of the second class, with greatly reduced sectional area at the middle, is the design *D*, of which 2,000 were tried in 1918 by the Italian State Railways on the line between Rome and Florence. In this design the ends are circular blocks with enlarged bases, while the middle is of inverted trough shape. But these transverse

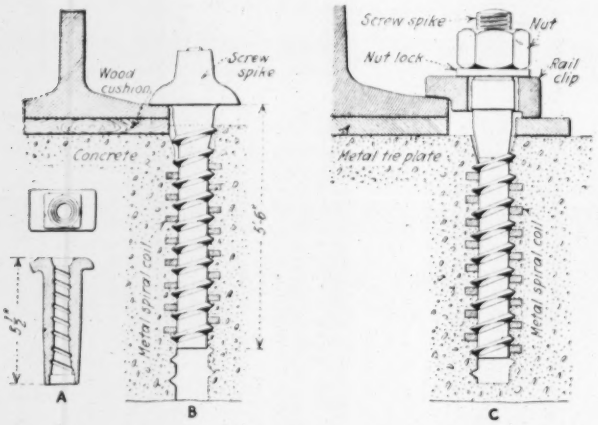


FIG. 3—RAIL FASTENINGS WITH CONCRETE TIES
A, threaded sleeve for screw spike. *B*, screw spike with mushroom head, in threaded hole with metal spiral. *C*, modified design with rail clip and nut on screw spike.

connections broke in a few months and allowed the track to get out of gage, so that after ten months' service all the ties were removed. The Vagneux tie, *E*, has been tried in France and found satisfactory for narrow-gage and light traffic lines, but unsuitable for main lines carrying fast and heavy trains.

Composite Ties—As already stated, Mr. de Veali prefers this type, in which two reinforced-concrete blocks are connected by steel tie-bars. The Vagneux tie of this type (Fig. 2) is used on the Paris, Lyon & Mediterranean Railway (120,000), the Northern Railway (100,000) and other railways in France, as well as in Switzerland and on the colonial railways of Algeria, on all of which it is said to have given good results. The blocks are approximately 13⅜ in. wide, 28⅜ in. long and 7½ in. high, connected by a 3¼-in. tie-bar of I-beam section. In two lots of 700 and 400 ties examined by Mr. de Veali in busy main tracks after three years' service only five and two ties respectively showed signs of cracks or disintegration. A modification of this design as used on the North Milan Railway, with somewhat less reinforcing steel, has the blocks 29 in. wide, 27½ in. long and 7¾ in. thick, with the rail fastening shown at Fig. 3. In manufacture, the forms are removed in two or three days, according to the season, and after the steel tie-bars have been painted the ties are stacked in tanks, so that the final setting of the concrete takes place under water. A double tie sometimes used at the rail joints is shown also in Fig. 2.

Rail Fastenings—While various forms of fastenings are used to attach the rails to concrete ties, they are in general either drive spikes or screw spikes in wood plugs or blocks embedded in the concrete. This type of fastening is considered objectionable, as inevitably becoming loose in service. Bolts the author also disapproves, whether fitted loose in cored holes or embedded in the concrete, the latter arrangement not admitting of replacement of broken or bent bolts. Another method is to embed in the concrete cast-iron sleeves threaded on the inside to receive screw spikes, as shown at *A*, Fig. 3.

A fastening preferred by Mr. de Veali consists of a metal spiral embedded in a cored hole, the concrete surface of which is threaded to fit a screw spike. This is a development of the Thiollier fastening as used in wood ties. In making the tie, the spirals are threaded on greased screw spikes and placed in the form, the spikes being removed after the concrete has set. This system, shown at *B* in Fig. 3, is used by the Italian State Railways. It is a feature also of the Vagneux tie already mentioned, but varying in detail, as shown at *C*. In this latter case, the spike has no mushroom head to bear upon the rail, but has its upper end threaded and fitted with a rail clip and nut. The spike holes are lined with bitumen, and before the spikes are applied they are dipped in melted pitch.

Emperger Tie—A design not included in Mr. de Veali's paper is shown in Fig. 4 and deserves mention as

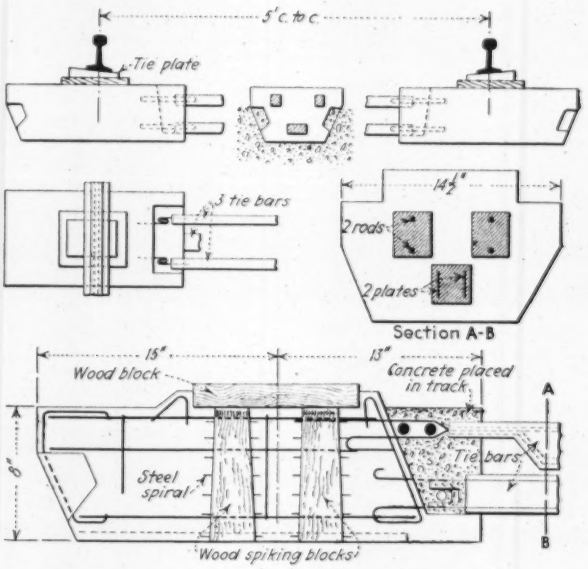


FIG. 4—EMPERGER CONCRETE TIE

being an invention of F. Emperger, an Austrian engineer and specialist in reinforced concrete. It has the peculiar feature of consisting of separate blocks and tie-bars when built, but when these parts are assembled in the track they are concreted together to form a single unit. Further, the tie-bars are of reinforced concrete, with the steel rods projecting so as to be interlocked with the steel of the two blocks in open pockets, which are then filled with concrete. The two upper bars have steel rods, while the lower one has two flat plates on edge. It will be noted that the sides and ends of the blocks have recesses, the purpose of these being to get a good grip in the ballast. Wood blocks embedded in the concrete, which is reinforced by steel spirals around the holes, receive the screw spikes which hold the rails. According to the *Génie Civil*, of Paris, trials have been made on the Austrian State Railway, and the cost of the ties does not exceed that of wood ties, which statement refers probably to ties of treated wood.

Traveling Gallows Frame Used in Placing 125-Ft. Bridge Girders

Soft Fill Bars Heavy Erecting Equipment on Long Railway Spans—Hammer Hung From Two Lines Drives Falsework Piles

By C. R. St. Clair
Engineer, Kelly-Atkinson Construction Company, Chicago

IN PLACING three spans of 125-ft. girders on the new Big Creek bridge of the Pennsylvania Railroad near Marshall, Ill., a light derrick car and traveling gallows frame were used instead of the usual heavy erection derrick because of the soft condition of a 75-ft. freshly placed approach fill. The bridge, part of the road's double-track improvement on the St. Louis division, was built downstream from the old structure on account of the line and grade revision across Big Creek valley, and this permitted its erection free from traffic. The approaches required 500,000 cu.yd. of fill 75 ft. high.

The structure consists of three deck-girder spans of 125 ft., carried by two concrete piers and two special

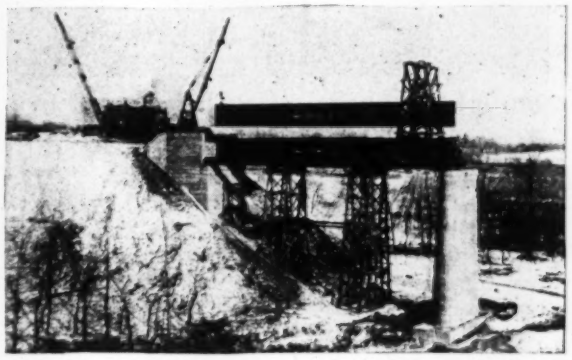


FIG. 1—PLACING 125-FT. BRIDGE GIRDERS WITH TRAVELING GALLOWS FRAME

Girder in position, swinging from traveling tower and derrick, ready to be landed on bridge seats.

pier type abutments with the slopes extending through them and under the end spans. This type of abutment was developed by the railroad engineers because of the large masonry quantities which would have been required in this case had the usual type of abutments and wing walls been used. The substructure was built for two tracks, but only single-track spans have been placed at present. Each of the 125-ft. girders is 11 ft. deep and weighs 68 tons. From bridge seat to base of rail the distance is 15 ft. 3 in., and the bridge seats are 70 ft. above the bed of the stream for the center span and 60 ft. above the ground on the side spans.

The method of steel erection was governed by several conditions: (1) Erection had to proceed from the east abutment, as the west approach fill was incomplete; (2) the new fill required a mat of timbers supporting the track, with I-beams required to transfer the weight of half the girder to a derrick car; (3) it was necessary to unload the girders in a cut several hundred feet from the east abutment; (4) the soft condition of the fill prohibited the use of a derrick car heavy enough to handle the girders without assistance; (5) the single-track structure did not lend itself to the method of erecting girders with a pair of derrick cars at opposite ends of the spans.

FIG. 2—PLACING FIRST GIRDER OF THIRD SPAN

Erection Procedure—To meet these conditions, falsework provided for each span consisted of two frame towers supporting 30-in. I-beams carrying rails spaced 13 ft. center to center. On this track traveled a timber gallows frame constructed to straddle the bridge girders and equipped with a hoist to lift and carry the girders (Fig. 1).

Each girder was transferred from railroad cars to a pair of car trucks and was pushed ahead by the derrick car until the end of the girder projected about 15 ft. through the gallows frame. The girder was then swung from the gallows at one end and the derrick car at the other end and the car trucks were removed. The derrick car pushed the girders and frame across the falsework, and when in position, the girder was landed on the bridge seats. After the second girder of the first span had been placed in the same way, the gallows frame was picked up by the derrick car and lowered to the ground, a standard-gage track laid on the span and the falsework transferred to the middle span. The gallows was then hoisted onto the falsework and the erection operation repeated.

The same operations were again repeated in erecting the third span, with the exception that a second derrick hauled the gallows frame forward while the other pushed the girder.

Piles to support the falsework towers were driven by a steam hammer slung from a cable on the boom of the derrick car, without the use of leads. For piles beyond the reach of the boom, the pile hammer was suspended by two lines, one from the derrick and the other from the opposite pier (Fig. 3). A similar out-haul arrangement was used in placing the falsework bents beyond the reach of the derrick car boom.

The bridge was designed by E. Weidemann, engineer of bridges and buildings, Pennsylvania Railroad. Construction was under the supervision of I. W. Geer, chief engineer, Western Region, and E. E. Stetson, assistant

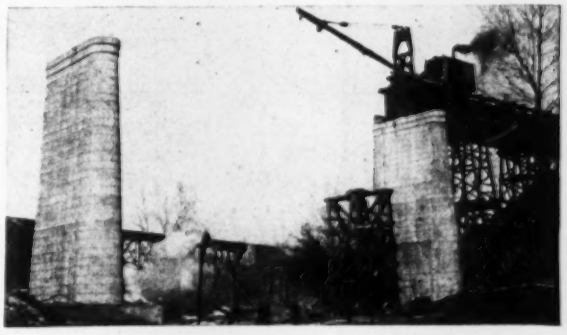


FIG. 3—DRIVING PILES WITH HAMMER HUNG FROM TWO LINES

to the chief engineer, with F. J. Hoberg, engineer in charge. For masonry, grading and tracklaying, the contractor was the Mellon Construction Company, Pittsburgh, with R. T. Belding in charge. Steel was fabricated by the American Bridge Company and erected by the Kelly-Atkinson Construction Company, Chicago, with the writer in charge of the work.

Tall Power House Frame Electrically Welded

Hotel Structure in Atlantic City, 134 Ft. High, One of Tallest Yet Welded—Lack of Noise a Factor in Choice of Welding

AN EXTENSION to the power house of the Haddon Hall and Chalfonte hotels, Atlantic City, N. J., was recently erected by arc welding, the prime factor in the choice of the process being the comparatively noiseless construction, it being desired not to disturb the guests of the hotels or the residents of the cottages in the neighborhood. The extension is 74x80 ft. in plan and 134 ft. high and thus ranks as one of the tallest building frames yet built by the arc-welding process. A total of six floors is involved, although the height is equivalent to that of a twelve-story office building. The first floor supports engines and compressors, the second floor contains the ash-handling facilities and the shop, the third floor the boilers, the fourth floor the ice-making machinery, the fifth floor the laundry and the sixth floor rooms for employees. All structural work on the building was completed within a month. In all, a total of 551 tons of H-section steel was utilized. The largest column is a 16-in. H weighing 427 lb. per foot. A view of the frame practically complete is shown in Fig. 1. Fig. 2 gives the second floor framing plan, with a diagram showing ceiling heights and floor loads.

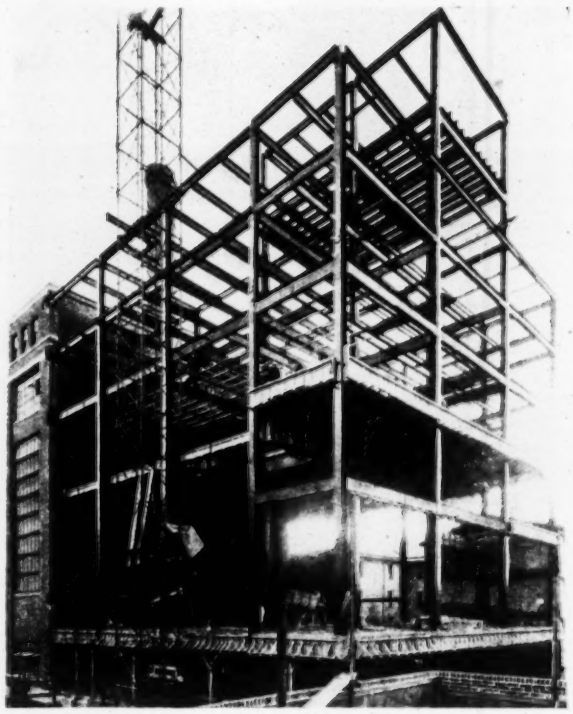


FIG. 1—POWER HOUSE FRAME 134 FT. HIGH FABRICATED AND ERECTED BY ARC WELDING

The original power plant, completed in 1926, was riveted both in the shop and in the field. The engineers on the new extension obtained the consent of the owners and architects to ask for alternative bids on the steelwork on a welded basis. The successful bid called for an addition of $100 if electric arc welding was employed in the field work. The successful bidder elected to shop weld all columns, to shop rivet all beams and girders as

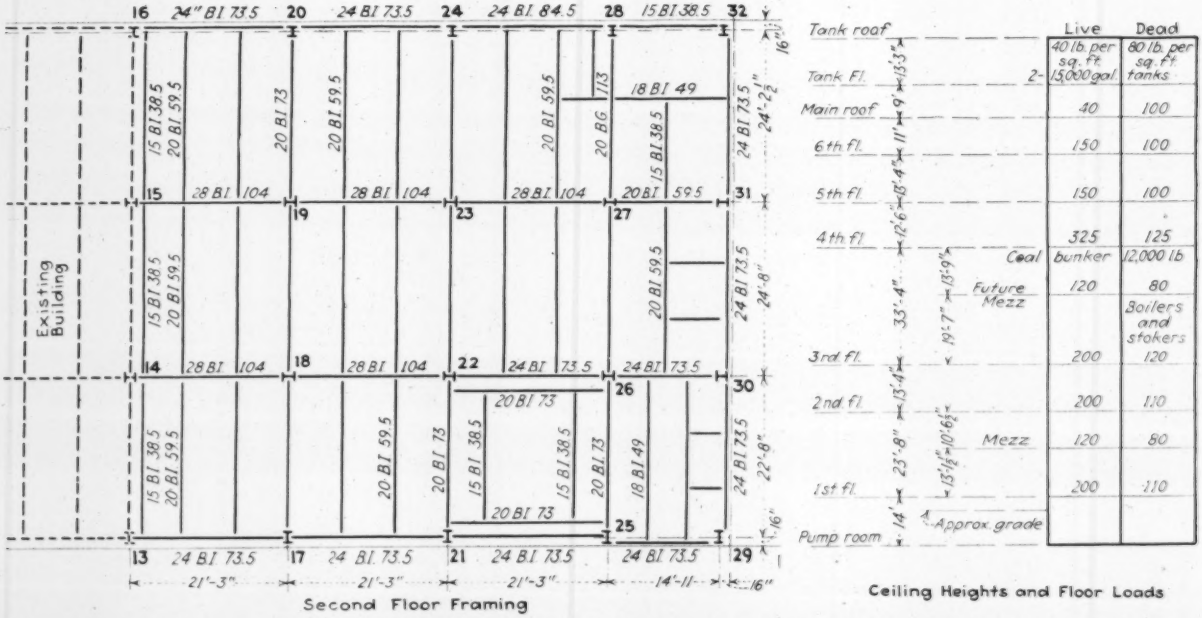


FIG. 2—FLOOR PLAN AND LOADS FOR HADDON HALL-CHALFONTE HOTELS POWER PLANT, ATLANTIC CITY, N. J.

required and to use bolts or bolts and welding in all field work. The result of this scheme was that all loads in the building are carried from the beams and girders to the columns either by shop or by field welds. Practically all connections of filling-in beams to girders are field bolted only.

Several clauses in the specifications referred specifically to welding procedure. For instance, one of the alternatives was as follows:

"Give addition or deduction if electric arc welding and bolts are substituted for all field welding. Shop work may be either arc welded or riveted, according to the best practice of the shop in which the steel is fabricated. Sufficient bolts and seats are to be provided so that the structure can be erected and plumbed before field welding is started, except that connections to present work must be done ahead of the erection. No permanent bolted connections will be permitted between main members and columns."

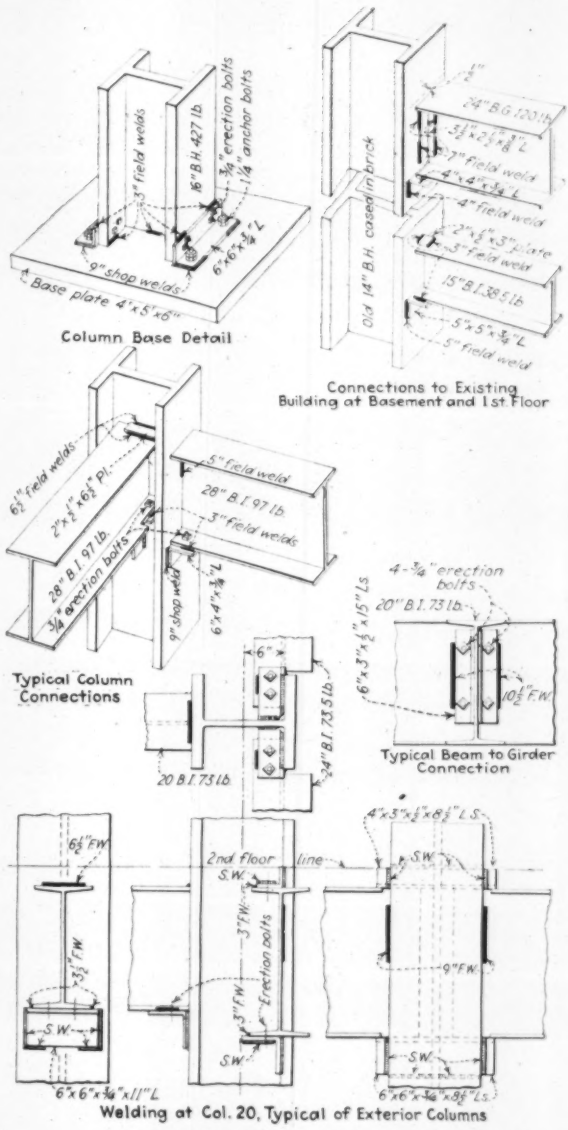


FIG. 3—DETAILS OF ARC WELDING IN POWER HOUSE FRAME

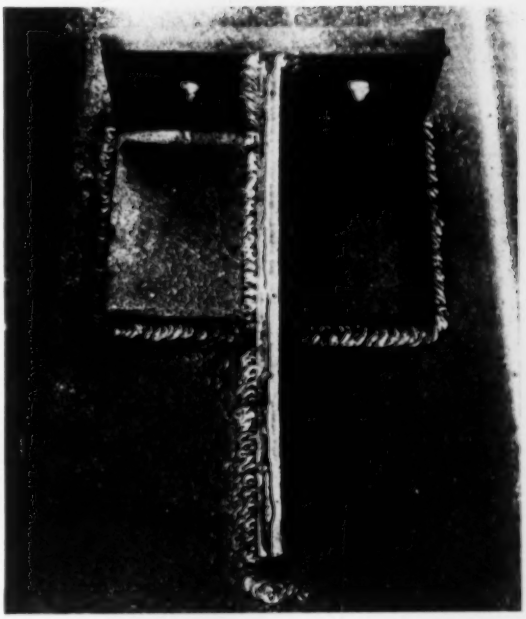


FIG. 4—WELDED BRACKET FOR GIRDER TO COLUMN CONNECTIONS

The specification clause on design read as follows: "When joints are designed for welding, the amount of weld metal specified for each joint shall be such that the minimum working fiber stress in any weld metal shall not exceed the following values for static loads:

Tension in weld metal (butt welds), lb. per sq.in.	14,000
Compression in weld metal, lb. per sq.in.	18,000
Shear on minimum sections of weld metal (fillet welds), lb. per sq.in.	11,300

"This is equivalent to 2,000 lb. per linear inch for $\frac{1}{4}$-in. fillets, 3,000 lb. per linear inch for $\frac{3}{8}$-in. fillets, 4,000 lb. per linear inch for $\frac{1}{2}$-in. fillets. All joints shall be designed in so far as possible to eliminate overhead welding and shall be arranged so that the welds will be in shear or direct compression. Tension welds shall not be allowed except for secondary connections. To the calculated length of each weld $\frac{1}{2}$ in. shall be added to allow for the crater." Shop painting was prohibited, but all steel was required to receive a coat of boiled linseed oil before leaving the shop.

In Fig. 3 are shown typical details in the building. The isometric view of a column base shows the largest column in the structure, which transfers a load of 750 tons to the foundation. The base angles were shop welded to the slab, thus facilitating the handling of the base, which weighed about 5,000 lb. All the erector had to do was hook into the open holes of the base angles and swing the slab into place on the anchor bolts. After the columns were in place and plumb, the angles were connected to the columns and the column direct to the slab by field welding.

The detail, also in Fig. 3, showing connections to the existing building, indicates the advantages of welding in making such connections. Since it was unnecessary to remove the fireproofing except on the face of the column, considerable saving in cutting and patching was made. The new beams were shipped longer than required and cut off in the field with a torch.

Fig. 4 is supplementary to Fig. 3 and shows the lower bracket detail, which is not visible in the typical column

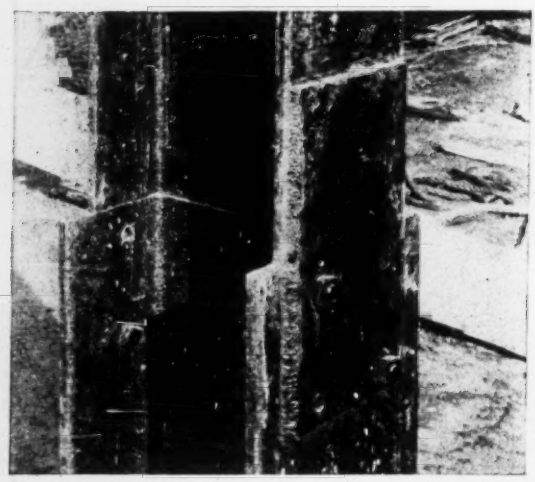


FIG. 5—COLUMN SPLICE COMBINING BOLTING AND WELDING

connection shown in Fig. 3. This bracket is composed of a 6x4x$\frac{3}{4}$x7$\frac{1}{2}$-in. angle and a plate stiffener 4x$\frac{1}{2}$x11$\frac{1}{4}$ in. The holes in the outstanding leg are for erection purposes. If riveted this bracket would have required one seat angle, one filler and two stiffener angles.

According to the engineers, the transition from an all-riveted to a riveted, bolted and welded job was comparatively simple. The main members, columns, girders and beams retained their same sections. No difficulty was experienced in detailing the beams which framed into the girders, since these used standard riveted connections in the shop, while in the field bolts were used. Some difficulties arose over the connections at the columns, which were all welded, but these were successfully overcome.

After the approval of the drawings, the beams and girders took their usual route through the shop. The columns were handled somewhat differently, being first milled and then marked for drilling. The first tier columns had eight holes at each end, while all the other columns had holes at one end only for the splice. After drilling, the columns were placed on I-beam skids, to which the detail material was routed from the punches. In general, the splices consisted of two plates 9x$\frac{1}{2}$x1 ft. 6 in., with four holes in each plate as shown in Fig. 5. The upper part was welded in the shop and the lower part bolted and welded in the field. Approximately 13,500 linear inches of $\frac{3}{8}$-in. fillet welds were required in the shop, and in many cases the welds ran as much as $\frac{7}{16}$ and $\frac{1}{2}$ in.

Erection was facilitated by providing at least two holes for erection bolts to connect beams and girders to columns. After erection and plumbing the bottom tiers of columns, the field welding was begun. In all, approximately 14,000 linear inches of $\frac{3}{8}$-in. fillet welds were used in the field work. As in the shop work, many of the welds were oversize.

The architects on the power plant were Rankin & Kellogg, of Philadelphia. Carson & Carson, consulting engineers, of Philadelphia, who supplied most of the above information, were responsible for the design. The Bethlehem Steel Company detailed, fabricated, erected, bolted and welded the entire skeleton framework. Frank P. McKibben, consulting engineer, General Electric Company, acted in an advisory capacity to the Bethlehem Steel Company and to the engineers in connection with the details and inspection of the work.

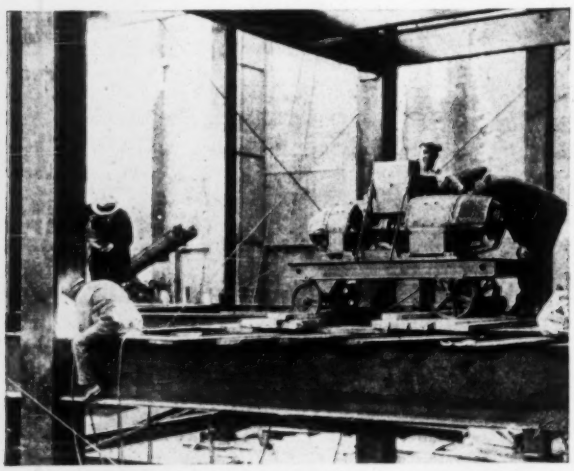


FIG. 6—WELDING A FIRST-FLOOR CONNECTION

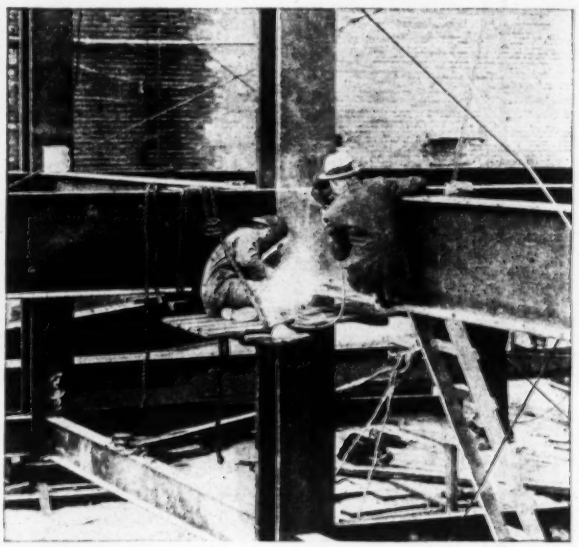


FIG. 7—WELDER WORKING ON A SWINGING PLATFORM

Steel Poles Used Because of Termite Attacks

The ravages of termites on wood poles was one of the main reasons for adopting steel pole-line construction in building several hundred miles of distribution system recently in the rural electrification program on the Salt River irrigation project near Phoenix, Ariz. The poles consisted of two special channels connected with a round lattice web member electrically welded to the channels and were used in lengths of 35, 40 and 45 ft. Holes were dug by boring machines equipped with a winch and mast to set the poles in the holes. The poles were embedded in concrete by a crew using materials previously distributed at each pole. The concreting crew and hole-digging crew worked at approximately the same speed, each completing 45 to 60 per day. Pole spacing was about fifteen to the mile along the 500 miles of new construction and 250 miles of reconstruction. Work was completed in eight months and the cost is reported to have averaged $1,200 per mile, which was practically the same as the estimated cost of treated wood pole lines.

Boeuf Floodway for Mississippi Flood Control

Fuseplug Levee South of Arkansas River Will Permit Boeuf Basin to Receive About One-Third of Estimated Superflood Down Mississippi—Control and Ring Levees Aggregate About 200 Miles — Hydraulic Computations

IN THE Mississippi flood-control plan, protection of the middle river from the Arkansas River to the Red River is provided by the Boeuf basin floodway, which will divert from the main river the flow in excess of 1,950,000 sec.-ft.—the amount which can be carried between the raised levees of this stretch of the Mississippi. Entrance to the floodway will be by a section ("fuseplug") of the present main river levee south of the mouth of the Arkansas and about 30 miles long. From the ends of the fuseplug levee, which (remaining undisturbed at its present level) will be 3 ft. lower than the raised levees to the north and south, floodway levees will swing inland and south, forming in conjunction with the highland of Macon (locally pronounced Mason) Ridge a broad channel extending some 155 miles south, substantially parallel with the Mississippi.

The map (Fig. 2) shows the levee lines of the floodway and the general topography of the Boeuf basin. It is to be noted that the southern end of the floodway at Sicily Island merges into the backwater area of the Red River. At the mouth of the Red River, diversion is again provided through the Atchafalaya floodway, which will be described in a succeeding article. Entrance to the Atchafalaya floodway is indicated on Fig. 2. One other feature of the general plan which is to be noted is that flood flow east of Macon Ridge is shut off; Bayou Macon will carry no Mississippi floodwater as it did in 1927.

Boeuf Floodway Structures

As shown by the map (Fig. 2), the floodway structures comprise the relief levee or fuseplug at the head; the control levees on the two sides of the floodway; and the ring levee around the city of Monroe, La. The relief levee is merely the present main river levee, which will be unchanged. The control levees and the Monroe ring will be new structures.

Control Levees—For comparison with the levee lines laid down on the main map there is inserted a portion of the map accompanying the report of the Chief of Engineers (Dec. 1, 1927) on flood control of the Mississippi. There is to be noticed a difference in the mileage of levee as the final plan was worked out. The change is particularly evident in the east levee line. In the final plan very much more levee construction is provided along Macon Ridge than was thought to be necessary when the plan was laid down. Though the two maps are not comparable in scale, the change is clearly evident. In the west levee line the original stretch of control levee well east of Monroe has been discarded since the time of the plan, and a small ring levee around Monroe has been substituted. There is also contemplated a ring levee around Arkansas City.

To follow the floodway levee location, begin at the hills south of Collinston, at the south end of the west levee. Curving out from the hills, the levee runs north and east, paralleling the Missouri Pacific Railroad and Bayou Bartholomew and protecting the towns along the railway and the lowlands all the way to its junction with the main river levee. South of the junction is the 30-mile stretch of fuseplug levee, extending to Luna Landing. Here the east control levee of the floodway begins.

From Luna Landing the east levee skirts along the high ground near the upper curved section of Lake Chicot, which is an old cutoff bend of the Mississippi, and passes southwest of Lake Village, about a mile away at the nearest point. From Lake Village it runs parallel to and east of Bayou Macon, which it crosses at Chicot, where the bayou turns to flow along the east side of Macon Ridge. From Chicot the levee continues to the north end of Macon Ridge, ending at superflood contour 126½, as shown by Fig. 1. The levee crest will be 1 ft. above this level.

In crossing Bayou Macon at Chicot the levee dams off the upper reaches of this stream, which will require a rearrangement of drainage. Diversion west to Bayou Boeuf is contemplated; three ditch connections are indicated, one of them shown on Fig. 1.

Returning to the levee line, Macon Ridge, as shown by Fig. 1, is quite narrow at superflood elevation. It

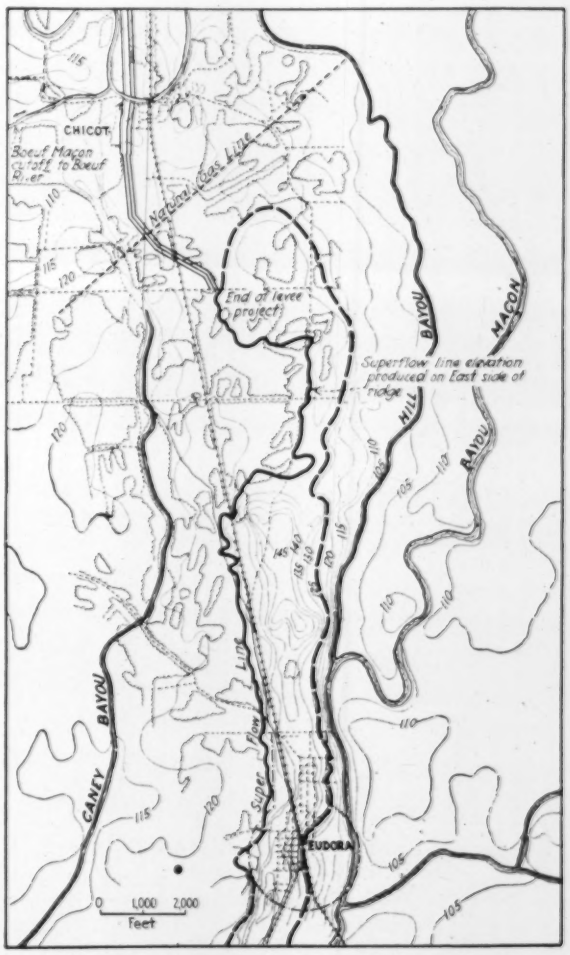


FIG. 1—MACON RIDGE AND LEVEE LOCATION
Note topography, drainage and superflood elevation contour.

continues high enough to retain the superflood from the end of the levee coming south to a point about 10 miles south of Eudora, where the levee again begins. This gap in the levee is about 15 miles. As indicated on the insert map on Fig. 2, it was anticipated in the original plan that some three times this length of ridge would replace levee. In its continuation south the levee location needs to be noted only in respect to its position between Bayou Colewa and Boeuf River and its swing into the floodway to encircle Rayville.

There are about 80 miles of west and 100 miles of east floodway levee. The location of 63 miles of the east levee, from Luna Landing to Rayville, has been finally approved and bids have been asked for 3 miles from Luna Landing to about 2 miles north of Lake Village. Court action prevents further progress pending decision on a landholder's plea for injunction, now before the federal court in Monroe, La.

Monroe Ring Levee—A vital feature of the floodway plan is a ring levee to protect the city of Monroe, La. This city, with its extension of West Monroe, has a population of about 25,000, and is located on the extreme west edge of the flood plain, as shown by Fig. 2. A plan of the city and of the flood-protection works so far as they have been determined is given by Fig. 3. Monroe is an industrial center of importance; its annual payroll is some $8,000,000. North of the city are gas fields with the carbon black industry, carrying a payroll of $1,250,000. West, north and northwest is the Monroe gas field, 400 square miles of proved territory. East and southeast partly in the floodway area is a new gas field of great extent not yet fully defined.

The ring levee, as shown by Fig. 3, starts at the Bastrop Hills, about 7 miles northeast of the city, and swings south and west to the Ouachita River, keeping about the same distance away from the city at all points of the ring. As indicated on the drawing, bids have been received for the east and south levees; further action is held up by the court proceedings previously mentioned. Plans have not been announced for the west side levee or the sea wall which is contemplated along a portion of the city front on the Ouachita. In all, the present contracts call for 3,842,000 cu.yd. of levee at Monroe, in eight sections ranging from 400,000 to 567,000 cu.yd. each. The low bids on these sections range from 21.54c. to 28.56c. a yard.

The floodway levees were determined on the assumption that with

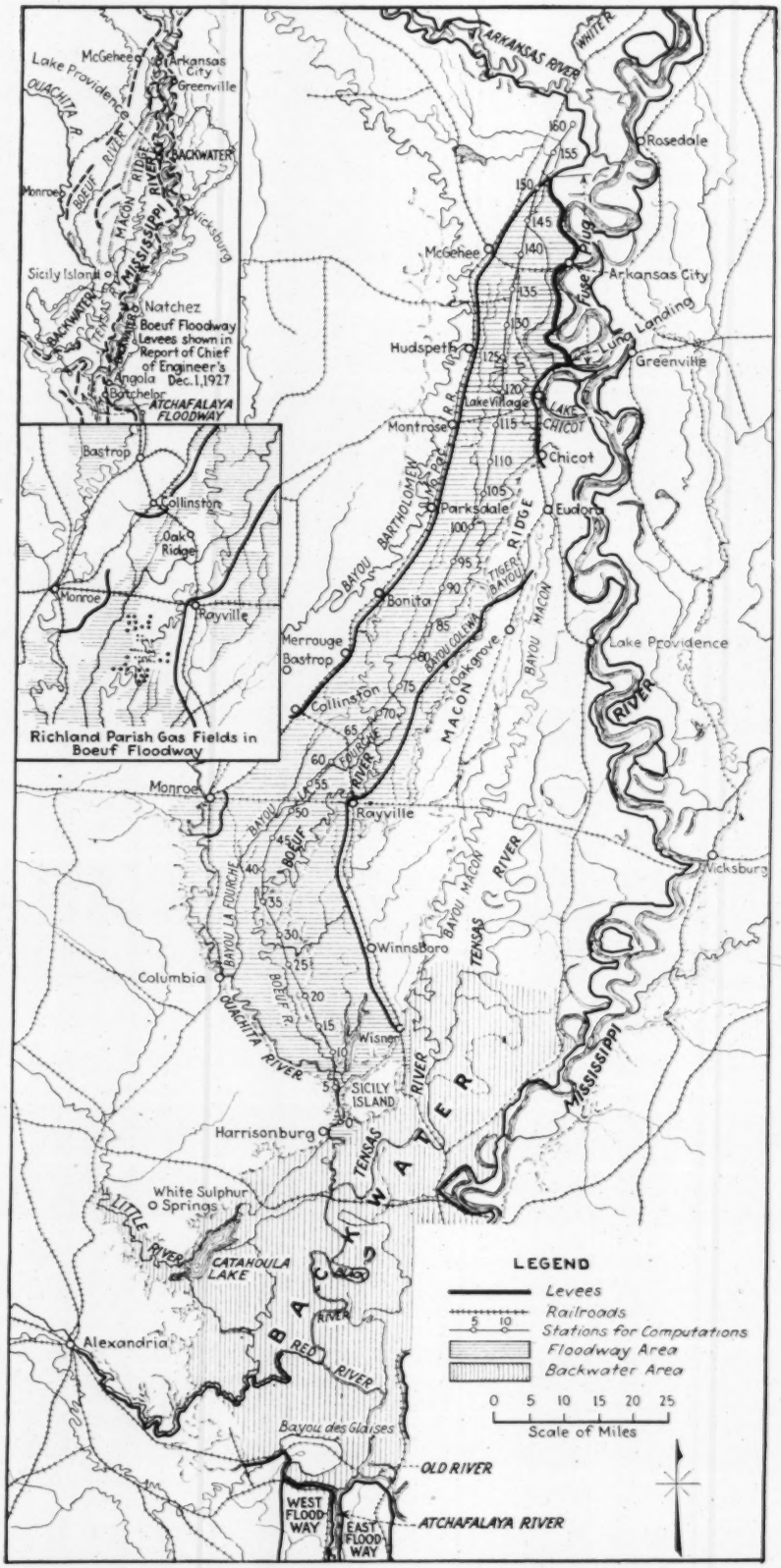


FIG. 2—LOCATION MAP OF BOEUF BASIN FLOODWAY

Inserted map shows first estimate of floodway levee locations. Another insert shows gas field in floodway. Topography, levee location and location of computed cross-sections indicated.

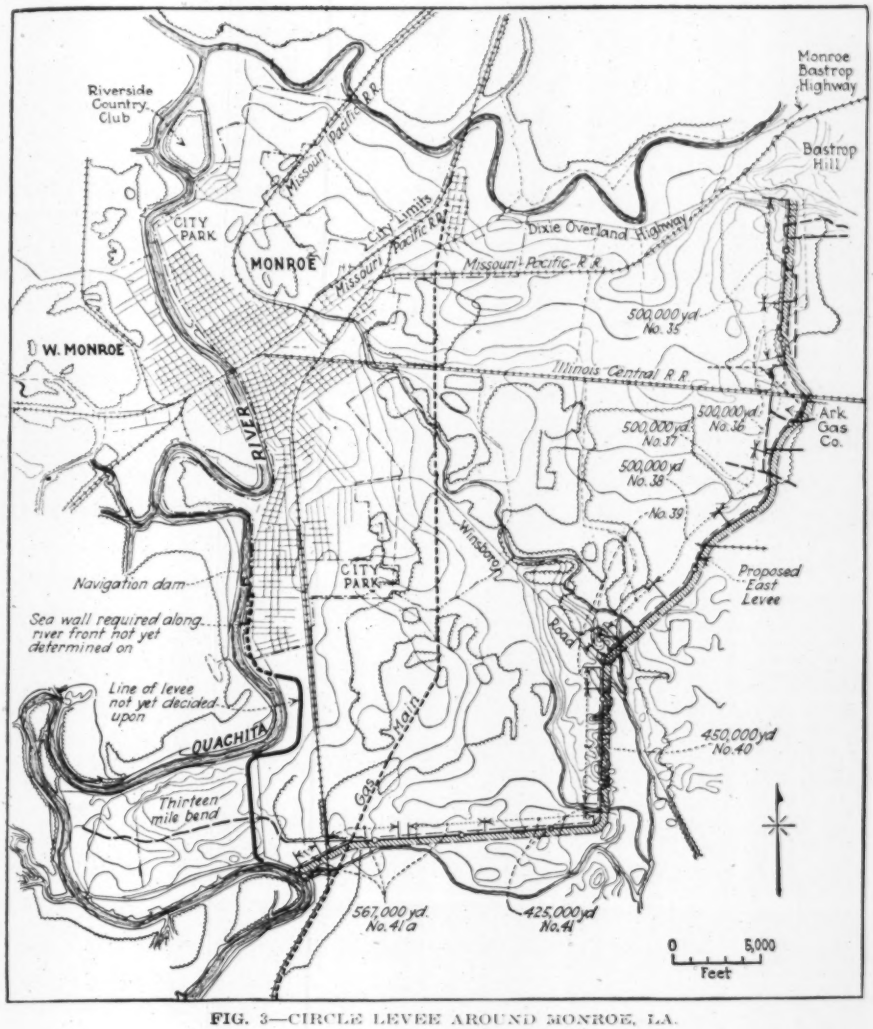


FIG. 3—CIRCLE LEVEE AROUND MONROE, LA.

a flood stage of 62½ ft. on the Arkansas City gage the main river will carry 1,950,000 sec.-ft. and all excess over this is to pass the fuseplug into the Boeuf basin. Levee elevations were determined to provide 1 ft. freeboard above backwater. The four factors affecting backwater elevations were assumed to be (1) topography of the overflow channel, (2) roughness of the overflow channel, (3) quantity of water discharged per second through the channel and (4) elevation of pool into which the channel discharges.

The hydraulic dimensions of the channel as affected by the topography were measured by very careful study of the existing maps, by supplementary mapping of the critical sections, by thorough personal reconnoisance, by analysis of the passage of the 1927 overflow from the gage records and high-water marks and by scaling, combining and averaging elevations from 2,000 miles of cross-sections over which profile levels had been run.

The roughness of the overflow channel was estimated in many reaches from the density of the vegetation, the amount of cleared land and consideration of all known measurements of the roughness coefficients under comparable conditions. The backwater curve is based on the use of Kutter's formula with $n = 0.150$ throughout the entire floodway.

The quantity of water discharged through the floodway under conditions which will obtain at the most critical stages of the superflood was determined by careful consideration of the probable daily rates of inflow, storage and outflow during the superflood. A superflood which had a peak inflow rate into the Arkansas-White backwater pool from the main river and tributaries of 3,300,000 sec.-ft. was used. If such a flood were wholly confined to the main channel by levees at existing locations but raised to heights above 75 ft. Arkansas City gage, it would rise to a peak outflow rate of 2,850,000 sec.-ft.

Repeated trials in successive approximations indicated that after allowing for storage within the floodway and reduction of storage outside the floodway, the maximum stages which might be produced along the lower 125 miles of the floodway would be equivalent to those produced by a temporary flow of 1,250,000 sec.-ft. The average discharge rate through the valley, however, over a period of ten days at the peak of the flood will probably be less than 900,000 sec.-ft. For longer periods the average will be less. The actual stages in the upper end depend also upon several other factors, one of the most important being the distribution of inflow along the fuseplug. The maximum values obtained by the various assumptions are used. The peak rate of flow in the main river will be 1,950,000 sec.-ft. as the fuseplug is breaking, giving a maximum stage of 62.5 at Arkansas City. Thus a peak main river outflow rate of 2,850,000 sec.-ft. in this latitude will be reduced by about 900,000 sec.-ft.

The elevation of the pool into which the floodway discharges was determined by the operation characteristics

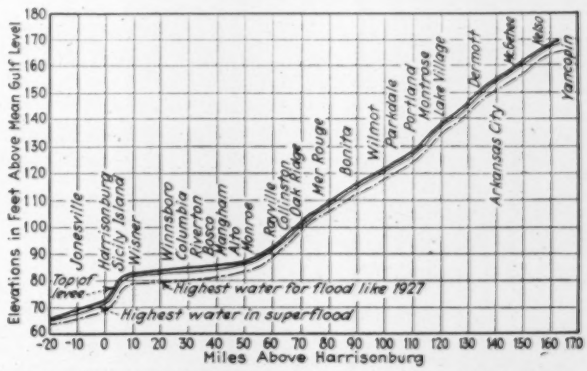


FIG. 4—PROFILES OF BACKWATER CURVE AND LEVEE ELEVATIONS

of the Atchafalaya floodway. The latter is designed to keep the maximum stage at Angola below 59.5 on the gage (63.1 ft. above mean Gulf level, 2 ft. above fuseplug levee along Old River and Bayou des Glaises).

Having the elevation of the water surface at the lower end of a reach of the floodway, the quantity of water flowing per second, the roughness and the topography of the bottom, the elevation of the water surface at the head of each reach was determined by Kutter's formula. The reaches were taken short enough so that the assumption of uniform slope of the water surface along the reach would not cause appreciable error. The development of the backwater curve required repetition of the calculation for each reach in succession, beginning at the lower end of the floodway. The computed elevation of the water surface at the upper end of a reach which would give the necessary n, s and A to cause the flow, Q, through that reach became the given elevation of the lower end of the next reach above.

The computed elevations of the backwater curve with superflood peak stage at 62½ Arkansas City are shown by Fig. 4 and are given more precisely in Table I. As computed for each cross-section indicated on Fig. 2, the hydraulic characteristics of the floodway are given in Table II. The total volume of the floodway is given as 27,000,000 acre-ft.

River Levees

Besides the sections of east floodway levee north of Lake Village and the Monroe ring levee for which bids have been received, bids are being considered for raising Arkansas River and Mississippi levees. Bids on eight sections, 300,000 to 575,000 cu.yd. each, were received June 17 for Arkansas River levees. The total was 3,665,000 cu.yd. Low bids ranged from 24c. to 34.5c. All of these levees are in the vicinity of the three 1927 crevasses at Pendleton, Medford and South Bend.

On the Mississippi, enlargement of levees and raising them an average of 3 ft. is to take place for a practically continuous stretch of 64 miles above Rosedale to the Coahoma-Bolivar County line and south to Ashbrook Dike, which is 5 miles below the latitude of Arkansas City and 10 miles above the latitude of Greenville and the lower end of the fuseplug section. There is 14,200,000 cu.yd. in the eleven sections, varying from 697,000 to 1,731,000 cu.yd. in each, the longer sections being arranged for continuing contracts of two and three seasons.

TABLE I—TENTATIVE GRADE LINES FOR BOEUF RIVER BASIN

(Flow beginning when water tops existing levee, corresponding to 62.5 on the Arkansas City gage, increasing to maximum possible with greatest predicted flood and then decreasing to zero at bank full stage. All elevations referred to mean Gulf level)

Latitude	Flow Line Flood, 1927	Flow Line Superflood	Levee Grade	Approx. Height Levee Top Above Ground Level, Ft.
		West Side		
McGehee	154	157	158	13
Dermott	146	149	150	12
Montrose	129	131	132	7
Portland	124	127	128	7
Parksdale	119	122	123	9
Wilmot	116	119	120	8
Bonita	111	113	114	9
Mer Rouge	103	105	106	22
Collinston	92	94	95	15
Monroe	83	86	87	17
		East Side		
Luna Landing	148	149	151	26
Lake Village	134	137	138	17
Chicot	124	127	128	8
Eudora	120	123	124	Macon Hills
Oak Grove	112	114	115	Macon Hills
Rayville	90	92	93	11
Mangham	82	85	86	14
Winnsboro	80	83	84	12
Wisner	79	82	83	8

TABLE II—HYDRAULIC CHARACTERISTICS OF BOEUF FLOODWAY

(For discharge at peak of superflood)

Mi. Above Harrisonburg	Area of Section (Sq.Ft.)	Hydraulic Radius (Ft.)	Slope	Mean Velocity (Ft. Per Sec.)	Elev. Water (Ft. Above M.G.L.)
10	1,910,000	22.6	0.0000235	0.65	81.8
15	2,200,000	20.8	0.0000201	0.57	82.4
20	2,260,000	22.1	0.0000174	0.55	82.9
25	2,380,000	22.3	0.0000148	0.52	83.3
30	2,440,000	20.9	0.0000159	0.51	83.7
35	2,590,000	20.4	0.0000144	0.48	84.1
40	2,020,000	20.0	0.0000262	0.62	84.6
45	1,780,000	19.7	0.0000337	0.70	85.4
50	1,610,000	19.2	0.0000500	0.78	86.5
55	1,150,000	17.1	0.000102	1.00	83.5
60	1,200,000	15.7	0.000136	1.04	91.7
65	1,260,000	13.3	0.000174	0.99	95.8
70	1,260,000	12.3	0.000197	0.99	100.7
75	1,400,000	14.0	0.000121	0.89	104.9
80	1,320,000	14.8	0.000121	0.95	108.1
85	1,210,000	15.7	0.000132	1.03	111.4
90	1,200,000	17.4	0.000113	1.04	114.7
95	1,230,000	17.6	0.000102	1.02	117.6
100	1,100,000	17.5	0.000136	1.14	120.7
105	1,290,000	17.2	0.000098	0.97	123.8
110	1,130,000	16.2	0.000140	1.11	127.0
115	980,000	15.6	0.000208	1.28	131.6
120	970,000	17.2	0.000182	1.29	136.7
125	1,230,000	15.9	0.000121	1.02	140.7
130	980,000	15.2	0.000220	1.28	145.2
135	1,000,000	17.1	0.000170	1.35	150.4
140	1,120,000	18.8	0.000110	1.12	154.1
145	1,120,000	17.7	0.000121	1.12	157.1
150	1,020,000	18.2	0.000144	1.23	160.6
155	960,000	18.8	0.000155	1.30	164.6
160	1,260,000	21.3	0.000064	0.99	167.5

Alternative bids for work to be done by hydraulic or dry methods were asked on most of this work. In the hydraulic alternative, the required quantity was asked for, but material is to be placed not necessarily up to grade. Usually it must lie between a line 350 ft. riverward from the center line and the landside toe. Slopes are required to be made continuous and away from the levee, and no ponding is permitted. It is the intention to top out these hydraulic-fill levees with government equipment.

At three other points, Valewood, Fitler and Hagaman, eleven sections of about 500,000 yd. each are on this year's program. Bids for these were received June 17 and the low proposals range from 20c. to 23.75c. per yard. They were submitted by a dredging company. There has arisen much rivalry between the contractors employing hydraulic and dry methods. The bids of the latter ranged generally between 25c. and 35c. per yard.

Supervision

The Boeuf floodway operations are in the Vicksburg district, with Major John C. H. Lee, U. S. Engineer Corps, district engineer in charge. A. M. Todd is senior engineer civilian in charge of general engineering, and Major T. B. Larkin, U. S. Engineer Corps, is head of the operating division. The hydraulic computations outlined were made by Lieut. John P. Dean, U. S. Engineer Corps, office, Chief of Engineers, Washington, D. C.

Legal Doubts Involving Mississippi Flood Control

In the opinion rendered by Judge Dawkins at Monroe, La., on Aug. 13, in a suit to restrain government agents from proceeding with construction of the Boeuf floodway levees, the major legal question concerning the War Department's procedure in the work is stated as follows:

It cannot be denied that in so far as there will be a diversion of the waters of the main channel of the river and a directing of their course to the sea through these limited floodways or channels, property owners situated therein are called upon to suffer whatever losses may be entailed for the good of those whose protection is contemplated under the plan; and while the government may, for the purposes of commerce and navigation, construct levees and other works or improvements upon the banks or in the channel of streams, without liability to those who may suffer consequential damage, yet if the work in contemplation in this

instance is not for such ends, but mainly for the benefit of other private property, then does there not arise in bar of that course the inhibition of the Constitution that private property shall not be taken for public purposes without just compensation? The allegation that the War Department has not paid and does not intend to pay for the injuries claimed by plaintiffs is of course admitted by the motion to dismiss.

The six approval orders of President Coolidge covering the flood-control work as published in our issue of Aug. 29, 1929, p. 332, gave specific instructions as to payment of damages for lands. While the flood-control act of May 15, 1928, specifically limited review of the flood-control plans and the directions of the President to engineering features of the plans, the War Department in accordance with the terms of the orders has made no attempt to purchase title or flowage rights in the Boeuf floodway. It has proceeded to call for bids on the guide levees of this floodway without regard to the ownership of the lands within. The owners now complain that they are no longer able to obtain loans on their property.

Tentative Incinerator Requirements for San Francisco

TENTATIVE suggestions for specifications for a garbage and refuse incinerator for San Francisco are given in a report just made to Mayor Rolph by M. M. O'Shaughnessy, city engineer, following a trip to the East during July. Heat utilization is not recommended. Mr. O'Shaughnessy saw incinerators of six makes: *Decarie*, New York City; *Goder*, Minneapolis; *Heenan-Froude*, New York City; *Nye*, New York City, White Plains, N. Y., and Portland, Ore.; *Sterling*, Toronto, Ont.; *Superior*, Chicago. The general conclusion of his report and also his outline for specifications follow:

My inspection of the various plants visited, taking into account such figures as were available at the time of my visit and fully realizing that official figures were lacking in some instances, leads me to state that the type of plants now in use in Toronto [*Sterling*] and Portland [*Nye*; labor costs only were available] appear to give the best results in reference to cost of operation, also the appearance of the interior and exterior of the plants and absence of nuisance, and are commendable.

I find from my observations of all plants visited that as a result of experience gained on the part of the manufacturers during the last twenty years in the construction of incinerators they are rapidly overcoming various defects and have now acquired fairly complete knowledge of furnace and plant construction. It would be advisable [to obtain] and I recommend obtaining, the benefits of competitive open bidding of selected types, rather than to specify any particular make or type of plant.

In calling for bids, I recommend setting up certain requirements, which would tend to limit the bidding to such firms as have sufficient means and have plainly established their ability to construct guaranteed plants under bond, complying with such requirements. Among such requirements would be the following:

Mr. O'Shaughnessy then gives as "among such requirements" a list which is printed below—with side headings inserted and with the "guarantees" condensed (without omissions of essentials) and rearranged in logical order:

Experience—Bidders should have an established reputation as builders of incinerating plants for the past ten years and should have at least one plant of 300 tons capacity for 24 hours in actual operation for two years on a practical basis.

Guarantees—Man-hours per ton of refuse burned; pounds of refuse burned per square foot of grate area per hour; statement as to the use of additional fuel; temperature limits in furnaces, combustion chamber and stack; no nuisance shall be created by escape of gases, odors or dust from chimney; power consumption.

Two-Year Bond—Contractor should be bonded for at least 100 per cent of the cost of the plant over a two-year period, to cover guarantees.

Building Included—As the building is really an integral part of the plant, it is recommended that the bidders compete on a complete plant consisting of equipment, building and foundations, such construction to conform to the building laws and to the type or class of building specified.

Freedom in Awarding Contract—The city should not be restricted to the low bid and should be allowed to take into account all factors tending toward the best interests of the city.

It would further appear from the observations that refuse cannot be disposed of for $1 per ton, as is now being accomplished imperfectly in the old San Francisco plant, if all fixed charges, maintenance, operation and disposal of ash are taken into consideration. I mention this in view of the fact that an ordinance now in effect distinctly states that the maximum charge shall not be more than $1 per ton for disposal of garbage.

Compressive and Transverse Strength of Brick

THE April issue of the Bureau of Standards *Journal of Research* contains a paper reporting the compressive strength flat and on edge, and the transverse strength of 27 makes of bricks covering a range of conditions in method of manufacture and degree of burning. The attempt is made to correlate the variation in ratios of these different measures of strength with the various structural features of the brick. The following conclusions apply to the data thus presented:

1. The tendency of soft mud brick is to give higher unit strengths when tested on edge than when tested flat.

2. The "compacting effect" on the structure of the edge-set brick by the superimposed weight of the other bricks in the kiln is offered as a tentative explanation of the tendency toward higher strength on edge.

3. This tendency toward higher strength on edge is overcome by laminar and cracking structure in the case of certain bricks.

4. Soft mud brick tend to display less deviation in the ratio modulus of rupture to flat compressive strength than any of the other methods of manufacture, but even with these the ratio ranged between 0.13 and 0.26.

5. Auger lamination in end-cut brick appears to be associated with high ratios for modulus of rupture to flat compressive strength.

6. Die lamination in side-cut brick appears to be associated with low ratios for modulus of rupture to flat compressive strength.

7. The ratio of the compressive strength of brick tested flat to the compressive strength of brick tested on edge ranges from 0.74 to 2.3.

8. In view of the variation in the ratio of the compressive strength of brick tested flat to the compressive strength when tested on edge, there exists no general rule for converting values from one kind of test to the other kind.

9. The ratio of the modulus of rupture to flat compressive strength ranged from 0.426 to 0.070.

10. In view of the variation in the ratio of the modulus of rupture to compressive strength when tested flat, the possibility of inferring a compressive strength from a transverse test or vice versa is open to very large errors for any given make of brick.

Minimum Sewer Grades—Correction

A typographical error in the article on "Minimum Sewer Grades," by Ernest McCullough, in the Job and Office section of *Engineering News-Record*, Aug. 8, 1929, occurred in the equation near the top of p. 229, second column, x being printed instead of z. The sentence referred to should read: Selected points on this curve produced the following empirical expression, $x = 100s = 0.0215z - 0.0015z^2 + 0.000033z^3$ in which $z =$ 48 — diameter in inches.

News of the Week

Changes in Plan of Government Up in Two Ohio Cities

Ashtabula, Ohio, will vote on Nov. 5 on proposed amendments to the city charter, which aim, among other things, to do away with proportional representation. Ashtabula was the first city in the United States to adopt this plan, which has been in effect there since 1915. Two previous attempts to discard it have failed. In its place is offered a plan whereby seven councilmen would be elected at large.

Zanesville, Ohio, on Aug. 27, in an election in which only a few more than half the registered voters went to the polls, rejected the city manager plan of government by a three to one vote. Totals for the 59 precincts showed 7,015 against and 2,175 for the change.

Equipment Contracts Let for Subway in New York City

Contract for cars and motor equipment and for the equipment of power substations and for the installation of signal equipment on five sections of the subway were let on Aug. 31 by the Board of Transportation of New York City. A contract also was let for an additional section of the subway in the Borough of Queens for $4,822,704 to the George H. Flinn Corporation.

The contract for the signal and switching equipment has been divided between the General Railway Signal Company and the Union Switch & Signal Company in order that the whole work may be completed in eighteen months. Contracts for this work total close to $6,000,000 and for the 300 steel cars and 610 motors, $11,000,000.

School for City Planning to Open at Harvard

A school for city planning, the first in the country, will be founded at Harvard University next fall with the aid of the Rockefeller Foundation.

A chair of regional planning, given to Harvard by James F. Curtis at the end of the last academic year in memory of Charles D. Norton, who inspired the regional plan of New York and presided over its early developments, will be the nucleus about which the new school will be formed. No incumbent for the chair has yet been named.

The new school will be a graduate professional school, and will aim not only to train men to be professional city planners but to give a sound conception of city planning to men who are going to be architects, landscape architects, engineers or leaders in various public endeavors, so that they may be efficient co-operators in the comprehensive field of city planning.

Hoover Proposes to Appoint Commission on Public Land Use

Desirability of Turning Public Lands Over to State Control to Be Investigated

A PLAN to set up a commission of nine or ten members to study and report upon the proper disposition of public lands now under the control of the federal government was announced by President Hoover in a letter to the Assistant Secretary of the Interior made public at a conference of Governors of public-land states held during the latter part of August. Reference to this letter was made briefly in our news pages last week.

The chief value of the unappropriated lands, aggregating 190,000,000 acres, exclusive of the value of those reserved for parks, forests, minerals or power purposes, is for grazing. This value, the President points out, is steadily decreasing due to overgrazing, a condition which is bound to have a marked effect upon the soil and eventually on water supply. Practically none of these lands can be commercially afforested and none brings in revenue to the federal government. As they are used primarily by small farmers and stockmen, the President believes that they should be managed locally.

The President believes that control of the land in parks, forests and Indian reservations, and of mineral rights and power sites should remain with the federal government. Inasmuch as the royalties from mineral rights revert to the Western states either directly or through the reclamation fund, the reservation of such lands will make no hardship.

With this change in the land policy, the President proposes a simplification of the Reclamation Service to make its function chiefly that of providing for the storage of water and the administration of existing reclamation projects.

Government to Build 200-Mile Road in Northern Quebec

Addressing a meeting at Maniwaki, Quebec, recently, J. E. Perrault, provincial Minister of Highways, announced that the government had decided to build a new provincial highway, stretching a distance of 200 miles between Maniwaki and Amos, in the mining area of northern Quebec. Work will be started in the immediate future and it is hoped to have the whole highway completed within two years. The government recently completed a new highway between Ottawa and Maniwaki, a distance of 140 miles.

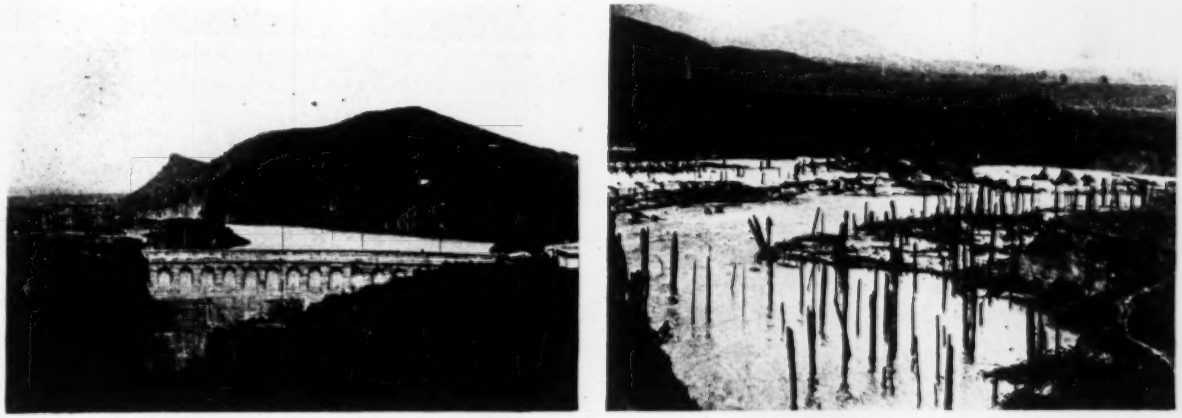
Memorial Highway to Connect Washington and Mount Vernon

Requests for bids covering hydraulic fills along the 15.4-mile Mount Vernon Memorial Highway between Washington, D. C., and Mount Vernon, Va., issued Aug. 27, indicate that construction work will soon be under way. The highway was first proposed many years ago, and its route was surveyed in 1889. Except in the portion through Alexandria, Va., the right-of-way will be 200 ft. wide, with a 40-ft. pavement and two 10-ft. shoulders. In certain sections, because of the topography of the ground, it will separate into two 20-ft. pavements at different levels. Seven monumental masonry bridges will be constructed, harmonizing with the Arlington memorial bridge, which provides access to the highway from Washington. These will carry a 60-ft. roadway with a 5-ft. sidewalk on either side. It is expected that the project will be completed in 1932, in time for the celebration of the 200th anniversary of the birth of George Washington.

Western Railways Plan Extensions

The Great Northern Railway and the Western Pacific Railroad have filed a joint application with the Interstate Commerce Commission for authority to build a 36-mile line extending from Lookout, Modoc County, to a connection at or near Hambone, Siskiyou County, Calif., with the eastern terminal of the McCloud River Railroad, which at Mount Shasta, its western terminal, connects with the Southern Pacific. At Lookout the new line would connect with the proposed line of the Great Northern running sout hfrom Klamath Falls, Ore., to meet the proposed line of the Western Pacific running north from Paxton (or Keddie), Calif. The two roads represent that the new link would provide a competitive outlet for the movement of traffic in the territory tributary to the McCloud River Railroad. Construction of the line is contingent upon favorable consideration by the commission of pending applications for authority to build the Klamath Falls-Paxton line.

An adverse report has been made to the commission by Examiner O. D. Weed on the Western Pacific's application to build a line from Quint St., San Francisco, 25 miles along the eastern border of the San Francisco peninsula to the plant of the Pacific Portland Cement Company at Redwood. This line would serve as the initial unit in an all-rail entrance into San Francisco, as the Western Pacific's plan contemplates a connection between the southern end of the proposeed line and its present line at Niles, 16 miles across the bay, either by



NEW ZEALAND HYDRO-ELECTRIC PROJECT UNCOVERS PREHISTORIC FOREST

View of the Arapuni dam, recently completed as a part of the power development of the New Zealand government. This 150-ft. diversion dam turns the Waikato River out of its present gorge into a former channel serving as a conduit to the penstocks. When turned into this old channel, the water unexpectedly washed through a deposit of pumice, bringing to view skeletons of a forest buried in past ages. About a mile below the point of diversion the water is returned to the present river channel through 12-ft. diameter penstock tunnels which have a head of 175 ft. Ultimate plans call for eight penstocks, each operating a 15,000-kw. unit. The principal use of the power is for the city of Auckland, served by a 110,000-volt transmission line about 104 miles long.

the use of the Southern Pacific's Dumbarton bridge, if that can be negotiated, or by building its own bridge. Recommending that the application be dismissed by the commission, Examiner Weed stated that as the proposal for a connection with its present line at Niles has not been placed before the commission, the peninsula project must stand upon its own merits as an extension of the Western Pacific Railroad into the new territory. The Redwood extension would parallel the double-track line of the Southern Pacific, and Examiner Weed finds that there is no justification for such a duplication of facilities.

The Yreka Railroad has filed an application with the Interstate Commerce Commission to construct a 35-mile extension from Yreka to Etna, Siskiyou County, Calif. The road serves as a feeder for the Southern Pacific, and the proposed extension would tap timber, agricultural and mineral resources not now accessible.

High Building Planned for Site of Waldorf-Astoria Hotel

Plans for an 80-story office building nearly 1,000 ft. high to be built on the site of the Waldorf-Astoria Hotel at Fifth Ave. and 34th St., New York, were announced recently by Alfred E. Smith, president of a new company recently organized to take over the hotel site. Plans for a 50-story building to occupy this site were announced in January of this year, and, although the hotel was vacated in May, the work of razing the structure was not undertaken. The site has a 200-ft. frontage on Fifth Ave and 425 ft. along 33d and 34th Sts., thus making possible the construction of an unusually tall structure under the provisions of the New York zoning law. The value of the site is placed at about $16,000,000, and the cost of the proposed building is expected to bring the total investment to about $60,000,000.

Many Highway Projects Pending in Chicago Region

Recommendations for the expenditure within the next few years of more than $50,000,000 in highway improvements for the relief of traffic congestion have been made by several bodies in Chicago and vicinity, and include programs for elevated highways, street widening and grade separation. The Chicago Plan Commission has produced for the entire city a general plan of superhighways, consisting of three parallel routes from the Loop district directly west to the city limits. Financing plans are completed for only one of these, which is to be voted on this fall. It involves the construction of an elevated highway 80 ft. wide on a fill along the north side of the Chicago & Northwestern Railroad main line tracks to connect at the city line with the state highway to Elgin. Plans include a 20-ft. roadway for eastbound traffic and a 40-ft. roadway for westbound traffic (the outgoing load is more concentrated as to time), a 14-ft. sidewalk and a 6-ft. loading sidewalk adjacent to the railroad. Ramps would be constructed at half-mile intervals.

A program calling for 140 miles of widening existing 20-ft. pavement to 40 ft., 36 miles of new 40-ft. pavement, eighteen bridges, nine highway grade separations and 64 midway grade separations has been prepared by a local advisory committee appointed by Governor Emmerson, of Illinois. It is expected that these improvements will be financed by the 3c. state gasoline tax over a two-year period. Illinois counties get one-third of the tax collected, and Cook County purposes to spend its quota entirely within the city limits of Chicago on through-route lines. Location of the gaps in these routes within the city is being carried on by a separate committee.

Early in August a Cook County citizens' advisory committee reported on a $7,621,000 grade-separation program, recommending that immediate construction be started on 30 highway grade separations, eight combined highway and railway grade separations and three traffic circles. This would be financed by both state and county, and would necessitate a vote at the fall election.

Asphalt Paving Conference Program Announced

The eighth annual Asphalt Paving Conference will be held at West Baden Springs, Ind., Oct. 28-Nov. 1, under the auspices of the Asphalt Association, New York City, and the American Association of Asphalt Paving Technologists, C. A. Mullen, Montreal, Canada, secretary. The keynote of the conference, as already announced, will be consideration of low-cost surfaces for farm-to-market roads. Among the papers scheduled are the following: "Research as a Factor in the Low-Cost Road Problem," by R. W. Crum, director, highway advisory board of the National Research Council; "Low-Cost Asphalt Roads by the Retread Method," by A. H. Hinkle, maintenance engineer, Indiana Highway Department; "The Surface-Treated Sand-Clay Roads of Florida," by J. L. Cresap, chief engineer, Florida State Highway Department; "Causes and Control of Frost Action in Shoulders and Subgrades," by W. C. Buetow, chief engineer, Wisconsin State Highway Department; "Black Base Car-Track Paving in Cities," by J. H. Dingle, city engineer, Charleston, S. C.; and "Needed Improvements in Paving Plant Equipment and Methods," by John W. Davitt, engineer and contractor, Jersey City, N. J.

The use of asphalt for the paving of airports and landing fields will also come in for extensive discussion at the conference.

Summary of Work of Pan American Congress of Highways

A summary of the work of the Second Pan American Congress of Highways, which closed its sessions in Rio de Janeiro on Aug. 31 is given in a cable message from the chairman of the United States delegation, J. Walter Drake, to the Pan American Confederation for Highway Education, Washington, D. C.

Setting up the need for local transportation facilities as the basic principle of its deliberations, the congress recommended that all countries first make a careful economic, financial and transportation survey to determine their respective transportation requirements. It advocated next the construction of a large mileage of low-cost roads, particularly in the Latin American countries, to open new territory and to provide essential communication facilities, allowing further improvement to wait upon traffic development.

The congress approved the principle of the gasoline tax for road improvement funds, but opposed the diversion of income so raised to uses other than highway improvement. Another resolution sanctioned the issuance of bonds as a means of raising funds for initial construction. The congress also asserted its belief that all national road programs should be under centralized governmental control. It recommended that the respective governments follow the federal-aid act of the United States in assuming a national share and responsibility for highway improvement.

The congress resolved itself into a continuing body, and fixed Chile as the next place of meeting.

Hydro-Electric Power Plant Projected in Washington

The Western Washington Electric Light & Power Company, of Aberdeen, Wash., has just received a state hydraulics permit authorizing North River water rights for the proposed $2,250,000 hydro-electric power plant project in southern Grays Harbor County. Already under way along preliminary lines, the undertaking, to produce eventually 54,545 theoretical, or 25,000 installed, electrical horsepower, will require an appropriation of 5,000 sec.-ft. of water from the flow of the North River, a tributary of Willapa Harbor.

Rights were also issued by R. K. Tiffany, state hydraulics supervisor, for the impounding of a total of 272,000 acre-ft. of water in a reservoir to be headed with a concrete arch-type dam 153 ft. in height, 400 ft. along the top and 180 ft. at the bottom.

The development, to be completed on or before June 1, 1932, will have its power plant located at a stream point approximately 10 miles south of the south shore of Grays Harbor, according to plans on file in Olympia, Wash.

MEMORIAL BUILDING AND CITY HALL FOR CEDAR RAPIDS, IOWA

The new Memorial Building and City Hall which has recently been completed in Cedar Rapids, Iowa, is part of a civic development started in 1908 when the city acquired the site, an island in the Cedar River in the heart of the city. The building consists of a structural steel frame incased in Indiana limestone. An interesting feature is the use of open-web bar joists for the floor construction. It is reported that O. L. Leffers, consulting engineer, Cedar Rapids, the engineer in charge of the structural design, found that the total floor dead load for this structure with open-web bar joists was 4,125,000 lb., while with concrete tin-pan construction this load was 6,505,000 lb. and with concrete joists and clay tile, 7,475,000 lb.

RANDOM LINES

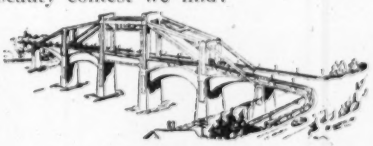
Hoover Behind the Gun

As Herbert Johnson in the *Saturday Evepost* imagines that President Hoover would handle the level.

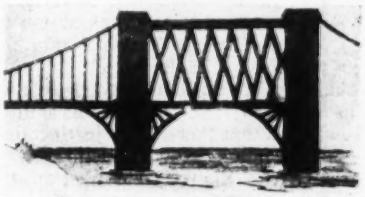
* * *

Artistic Bridges

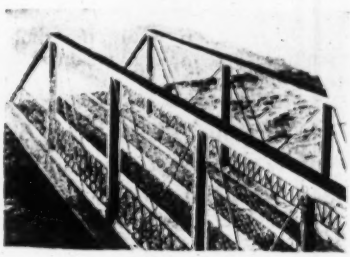
Beauty in bridge design is receiving much attention these days, not only from engineers but also from those of more artistic temperament who illustrate our magazines and newspapers. Among the entries in our own bridge beauty contest we find:



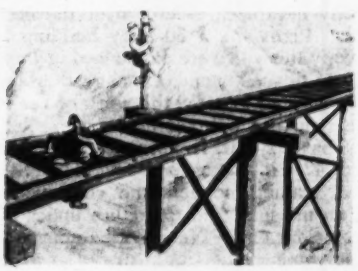
the open-faced type—



the unfinished symphony—



the center-fire tie-braced bridge—



and the Pat-and-Mike truss. (Can you blame them for getting worried?)

Brief News

A UNIFORM TRAFFIC CENSUS, the movement for which has been instituted by the Bureau of Public Roads, will be joined by New Mexico. The expense of the survey will be borne partly by the state and partly by the government.

ELIMINATION of railroad grade crossings in Louisville, Ky., is contemplated in tentative plans of the board of public works. The expense is estimated at $10,000,000, and the plans involve four railroad companies and eleven major grade elimination projects.

THE CANADIAN GOVERNMENT has decided to proceed at once with the entire scheme of national research laboratories in Ottawa, involving an outlay of $3,000,000. The original intention was to build only one unit, at a cost of $1,000,000.

A CLAIM for $1,100,000 has been filed against the city of New York by the Central M. E. Church, of Brooklyn. It is asserted that the vibrations of the subway caused the foundations of the 55-year-old church to be pronounced unsafe, and later the building had to be torn down.

CONSTRUCTION of a 320-mile railway line between Sivas and Erzerum, Turkey, has been authorized by the Turkish government at a cost of $28,000,000. Bids for the work have been presented by American, Swedish and German contractors. A line from Kaisariye to Sivas will be completed this year.

THE ENGINEERING BUILDING of the New Orleans River District headquarters was destroyed by fire on Aug. 17, with a loss of about $60,000. An electrical short circuit is believed to have been the cause. Maps and drawings of the Bonnet Carré spillway were consumed, but duplicates are available and progress of the flood-control projects in the district will not be impeded.

OCCUPANCY was taken on Aug. 21 by the Port of New York Authority of the research and testing laboratory recently completed in Jersey City. Previously testing work was done in rented quarters. One of the pieces of apparatus in the building will be a 1,000,000-lb. testing machine. This will be used for special tests of large reinforced-concrete beams, columns, slabs, etc.

TENTATIVE PLANS for the construction of a tram line over the new South Shore bridge, at Montreal, have been completed by the Montreal Tramways Company, and it is understood that proposals for a franchise are soon to be presented to the harbor commissioners. Present plans include the building of two terminals, one at each end of the bridge, and shelters for passengers.

THE MCCOMAS ST. TERMINAL built by the Baltimore Port Development Commission at a cost of $8,500,000, has been completed and will be turned over to the Western Maryland Railroad Company, lessee, on Sept. 16. The terminal will eliminate the use of lighters in transferring cargo and will accommodate seven ships.

Herbert Photo

GERMAN EARTH-HANDLING MACHINE OF UNUSUAL SIZE

This mechanism is being used in Leipzig, Germany, for leveling a hill and using the spoil to fill in the swamp shown on the right. Its immense size can be gaged by the figures of the two men standing by the caterpillars.

CONNECTION of Copenhagen, the capital of Denmark, with the continent will be completed by the construction of a 6-mile bridge between the island of Zealand, on which Copenhagen is situated, and the island of Funen. Plans for the bridge are now being prepared. Last year construction was started on a bridge connecting Funen with the mainland.

RIVER REGULATION, canalization and drainage work on eleven rivers is being planned by the Turkish government. The total cost is expected to reach 250,000,000 Turkish pounds, of which 100,000,000 Turkish pounds will be provided within the next ten years. Negotiations are now under way for the letting of contracts to American and German contractors.

MISSOURI'S STATE ROAD BOND ISSUE of $75,000,000 has been declared legal by the state Supreme Court. The money will be spent to complete the primary system of highways, relieve congestion of the metropolitan area around St. Louis and in the Kansas City district and build a "farm-to-market" system of roads supplementary to the state system.

SYRACUSE'S FLOOD-PREVENTION PROJECT, estimated to cost $3,000,000, will be started as soon as conferences with the Onondaga Indians and an agreement on terms for reservation and other lands to be taken have paved the way, it is stated by Glenn D. Holmes, chief engineer of the city's intercepting sewer board. Plans for two dams to hold back the waters of Onondaga Creek have been practically completed.

RAILWAY EXTENSIONS totaling 3,040 miles are planned by the Russian government within the next two years. Work has already been started on sections totaling 1,180 miles. A line connecting the Siberian Railway with the Persian frontier will be opened to general traffic in October. It is stated that in a distance of 1,050 miles only two major bridges were necessary and that during June an average of 1½ miles of track was laid daily.

APPLICATIONS for the positions of materials testing engineer, at $3,800 a year; associate materials testing engineer, at $3,200, and assistant materials testing engineer, at $2,600, will be received by the U. S. Civil Service Commission, Washington, D. C., until Sept. 11. There will be no examination, applicants being rated on education, experience and fitness, 70 per cent; reports or theses, to be filed by applicant, 30 per cent.

AN ALLOCATION of $2,000,000 for the work in connection with the improvement of the Missouri River from Kansas City to its mouth has been approved by the Secretary of War. By making this additional amount available it is hoped to speed up materially the completion of the 9-ft. project on the lower Missouri. Petitions are being received by the War Department asking that the work on the upper portion of the river be speeded up also.

TRAFFIC IN THE HOLLAND TUNNEL established a new three-day record over the week end including Labor Day, and a new daily record was made on the holiday. Tunnel officials counted the cars passing through the tubes as follows: Saturday, 47,800; Sunday, 49,139; Monday, 52,800; making a total of 149,739.

FLOOD-CONTROL REQUIREMENTS on the navigable streams within the jurisdiction of the states will be discussed at a conference planned by Representative Reid, of Illinois, chairman of the House flood-control committee. The establishment of state commissions to study the subject will be suggested, together with a survey of the utilization of water resources.

Civil Service Positions Open in New York State

Civil service positions are open in New York State for assistant sanitarians (assistant sanitary engineers), two appointments expected at $2,500 to $3,250 and three at $3,500 to $4,000; for junior assistant civil engineers, several for drafting and a large number for field work, at $1,980 to $2,400, and for special agent, class A, for engineering appraisal work, bureau of special franchises, one at $2,100 to $2,400. Examinations for these positions will be held Sept. 28 for those who apply before Sept. 14.

An examination will be held on the same day for applicants for the position of sanitary engineer, Suffolk County Department of Health, salary $3,600.

New York to Vote on Proposed Sanitation Commission

Mayor Walker, of New York, has signed the bill creating a sanitation commission and the proposal will be voted on at the election in November. The proposed commission would give supervision of sewage and garbage disposal and street cleaning throughout the entire city to one department head. The bill limits the powers of the Borough Presidents in Queens and Richmond, who now supervise street cleaning in those boroughs.

Additional Contracts for Drainage Work at New Orleans

As part of the $9,000,000 drainage program at New Orleans the city recently opened bids on drainage facilities for the uptown areas of the city, which call for the construction of open and covered canals and the enlargement of existing canals. The lowest bid was $1,250,000. The award of this contract will bring the total of contracts let under the present program to about $4,250,000.

Oil-Electric Locomotives for Rail Service at New York

Orders for 35 oil-electric locomotives of 300 hp. each for use in switching service on the west side of Manhattan Island have been placed by the New York Central Railroad Company. Under its contract with the city for the reconstruction of its tracks on the west side of the island to eliminate all grade crossings, the railroad agreed to discontinue the operation of steam locomotives within two years. The new locomotives are to be specially designed for convenience during this reconstruction period. In addition to their oil-electric drive, they are equipped for operation as electric locomotives either from a third rail or an overhead trolley or as storage battery locomotives.

The new locomotives are to be built by the American Locomotive Company, using Ingersoll-Rand oil engines and electrical apparatus supplied by the General Electric Company. The cost is estimated at $4,000,000.

Personal Notes

Prof. W. K. Hatt, head of the school of civil engineering of Purdue University, has received a leave of absence from his duties during the next academic year. He will sail from San Francisco on Oct. 11 to attend the World Engineering Congress in Japan, before which he will present a paper "Researches in Concrete," and will come home through China, India and other countries, arriving in the United States during April.

R. F. Hoffmark, general superintendent, A. Guthrie & Company, Inc., Portland, Ore., on Aug. 1 was appointed vice-president of the company. Mr. Hoffmark was graduated from Purdue University in 1906 and had construction experience in Panama, Oregon and Alaska before joining the staff of the Guthrie company, with which he has been associated for seventeen years.

John H. Gardiner, who has for the past eight years served as office engineer for the Arizona district of the United States Geological Survey, with headquarters in the University of Arizona, Tucson, has been transferred to the Fort Smith, Ark., district of the U. S. Geological Survey.

Frank Williams, for some time connected in an executive capacity with the Smith & Williams Construction Company, and R. W. Dethleefs, who has been with the Grahn Construction Company, both of Atlanta, Ga., have formed a new contracting company in that city under the name of the Williams Construction Company.

Frederick C. Wilson has been appointed dean of engineering at Clarkson College, an engineering institution located at Potsdam, N. Y.

James C. Roop, a graduate of the University of Pennsylvania electrical school, has been appointed director of the budget of the United States government. Mr. Roop was formerly with the J. G. White Management Corporation and the Woods Brothers Construction Company and also has had experience in electric railway operation.

Society Calendar

AMERICAN WELDING SOCIETY, New York; fall meeting, Cleveland, Ohio, Sept. 9-13.

NEW ENGLAND WATER WORKS ASSOCIATION, Boston; annual convention, Portland, Me., Sept. 16-18.

AMERICAN ASSOCIATION OF PORT AUTHORITIES; eighteenth annual convention, Quebec, Sept. 23-26.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; fall meeting, Boston, Mass., Oct. 9-11.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION, Chicago; annual meeting, New Orleans, La., Oct. 15-17.

ASPHALT PAVING CONFERENCE, New York City; annual meeting, West Baden, Ind., Oct. 28-Nov. 1.

MISSOURI WATER AND SEWERAGE CONFERENCE, in conjunction with the Missouri Association of Municipal Utilities; Chillicothe, Ohio, Oct. 21-23. H. D. Peters, assistant engineer, State Board of Health, secretary.

Obituary

Lewis I. Fletcher, a prominent contractor of Kent, Ohio, died suddenly on Aug. 12. Mr. Fletcher was a native of Marlborough, Mass., and moved to Kent in 1913. He was 63 years old.

Clement Stanley Smogor, a contractor, of South Bend, Ind., and a former member of the city board of safety, died recently from an apoplectic stroke. Mr. Smogor was widely known in northern Illinois.

Stoddard B. Bates, for thirteen years state highway commissioner of Vermont, died suddenly on Aug. 9 at the Pavilion Hotel in Montpelier of heart failure. He was 67 years old. He was appointed state highway commissioner in 1915 and held that position until 1921. For the next two years he was a member of the state highway board. In 1923 he was reappointed state highway commissioner and served until his death.

Albert E. Walden, former chief engineer of the Baltimore County Metropolitan District, Baltimore County, Md., died on Aug. 26 at his home in Hamilton, Md. He also was formerly general superintendent, engineer and purchasing agent of the Baltimore County Water & Electric Company, filling that position until the company was acquired by the city of Baltimore. Mr. Walden was a member of the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the National Electric Light Association.

Frank E. Kirby, designer and builder of more than 200 lake and river steamers, died at his home in Bronxville, N. Y., on Aug. 25. He was born in Cleveland 80 years ago, and after being graduated from Cooper Union in New York, he took up the study of shipbuilding in this country and in Scotland. As chief engineer of the Detroit Dry Dock Company he designed and engineered the building of all the steamers in use by the Detroit & Cleveland Navigation Company, the Cleveland & Buffalo line, the Detroit & Windsor Ferry Company, the White Star Line, and most of the car ferries for the old New York Central, Pennsylvania, Pere Marquette, Ann Arbor and other lake lines. He devised the ice-crushing ferries that ride up on the ice and crush it by sheer weight, and thus made the lakes navigable for longer periods. During the Spanish-American War he supervised for the government the selection of ships for transport duty, and in the World War, as consulting engineer for the government, he passed upon the Ford Eagle boats at the River Rouge plant. After the burning of the "General Slocum" in the East River, New York, he was appointed a commission of one by President Roosevelt and revised the safety code which today is the maritime law of the country.

Construction Equipment and Materials

Concrete Mixer Manufacturers Will Hold Trade Conference

Sept. 5 has been set as the date for a trade conference of the concrete mixer and paver industry to be held at French Lick Springs, Ind., under the auspices of the Federal Trade Commission. Among the subjects scheduled for discussion are contractual relations with agents and others, price rebates and discounts and the rating of products in regard to size, weight and capacity.

To Confer on Wire Rope Problems

Invitations have been issued to more than 200 manufacturers and users of wire rope for the Third Wire Rope Conference to be held in New York Sept. 13, under the auspices of the A.S.M.E. research committee with the assistance of the Engineering Foundation. The formal part of the program will consist of brief papers on the many applications of wire rope in the various fields of engineering and industry. Dr. Conrad Matschoss, director, Verein Deutscher Ingenieure, will be present and will tell of the studies now being conducted by the German wire rope committee. A report prepared by Dr. W. A. Scoble will also be read describing the work of the wire ropes committee of the Institution of Mechanical Engineers in Great Britain. The report will cover the accomplishments, present status and future plans of the British committee. It is expected that the conference will develop a comprehensive picture of the varied conditions surrounding the use of wire rope and will reveal lines along which further study might be made. All persons interested in the subject are urged to attend.

New Developments

Elevating Grader Driven by Tractor Power

With a greater capacity than any other model previously developed by the manufacturers, the Russell Sixty elevating grader now being marketed by the road machinery division of the Caterpillar Tractor Company, San Leandro, Calif., has an elevator belt 42 in. wide and weighs 12,800 lb. It is driven from the power take-off of the tractor, no provision being made for bull wheel drive, which usually results in considerable loss of power from slippage. Elimination of the wheel drive makes the construction much simpler. The lineshaft, countershaft bracket and

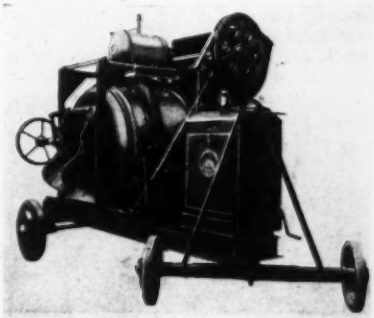
ELEVATING GRADER WORKING IN SOFT GROUND

wheels operate on roller bearings, and bronze bushings are used for both upper and lower drum shaft.

Other recent models announced by the company include a new model of the Super Reliance blade grader and of the motor patrols to be used with models 10 and 15 tractors. New features of the latter include an improved blade lift mechanism, simplified operating control, redesigned gear boxes and connections, and self-aligning connections between the tractor and grader frame.

Redesign Small Concrete Mixer

Large capacity, portability and speed are three factors to which particular attention was paid in redesigning the X-S mixer built by the Ransome Concrete Machinery Company, Dunellen, N. J. This is powered either by a Leroi or a Novo two-cylinder gasoline engine, or by an electric motor. A flexible coupling connects the engine take-off shaft to the gear reduction unit. The mixer is mounted on either rubber tire steel disk wheels with roller bearings or steel tire spoke wheels with plain bearings. It will turn in a circle having a radius of 13½ ft., and is equipped with a power loader which raises the skip in from seven to eight seconds. Water is passed through a 13-gal. measuring tank equipped with a non-bypassing poppet valve and graduated dial indicator, together with glass gage.



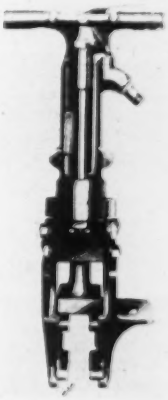
7-S CONCRETE MIXER WITH GASOLINE POWER

New Facing Metal Developed to Give Wear-Resisting Surface

Two special alloys of great hardness are being manufactured in commercial quantities at the present time by the Commercial Alloy Corporation, of San Francisco, Calif., and marketed under the name of Cristite Series 1 and Cristite Series 3. Cristite Series 1 shows a hardness on the Rockwell C scale of 61 to 67, while Cristite Series 3 shows a hardness of 49 to 55. Both of these alloys can be easily flowed onto a steel surface by means of ordinary welding equipment and are manufactured in the form of rods for this purpose. Cristite Series 1 is being used for facing earth-boring tools, for airplane valves, for airplane tailskids and for facing hammers of grinding and crushing equipment. The Series 3 alloy is being used for hard facing of stamp mills, railroad crossings, etc. It withstands impacts much better than Series 1, which contains tungsten and is more brittle.

Pneumatic Sheeting Driver

By adding a special front end to the CP-6 demolition tool, the Chicago Pneumatic Tool Company, New York City, has produced a pneumatic sheeting driver for use in trench work and excavation with both wooden and light steel sheetpiling. The machine, which weighs 405 lb., can be adjusted to take various thicknesses of sheeting from 1½ to 3 in. By changing the front end, the sheeting driver can be converted into a demolition tool.

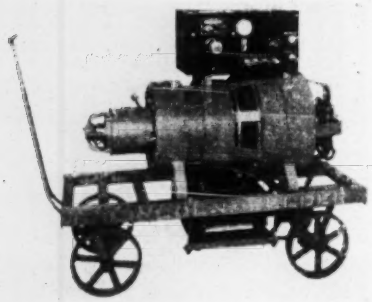


SHEETING DRIVER

Welding Simplified by Use of New Welder and Rod

Simplification of control is the outstanding feature of a new electric welder announced by the Lincoln Electric Company, Cleveland, Ohio. The working mechanism of all controls is contained in a ventilated inclosed steel cabinet with hand regulators and switches mounted on a panel on the side. This panel contains rheostat regulator, diverter switch, safety starter switch, volt-ammeter and wing nut terminals for the cables. Being mounted directly over the motor generator, this cabinet is easily accessible to the operator and also permits removal of the motor generator armature without disturbing other parts. The wiring of all operating control is inclosed. Use of a shorter frame or base than in previous models

is made possible by this change in the position of the control box. Terminals for the lead cables are equipped with winged nuts, making quick connections possible, and eliminating the necessity



ACCESSIBILITY A FEATURE OF A. C. WELDER

of a switch for reversing polarity. Longer instrument life is assured by the use of a combined voltmeter and ammeter, the current voltage and amperage being read on one dial. Accidental starting of the machine is made impossible by the use of a push-button switch for starting and stopping.

The Lincoln Electric Company has also developed a new welding rod electrode for use in welding mild steel and for cast-iron repair work. It is claimed that by using this "New Kathode" welding electrode, greater speed is possible without sacrificing quality, as the electrode fuses easily with deep penetration. It is manufactured in stock lengths of 14 and 24 in.

Conical Rollers Used in Railway Cattle Guard

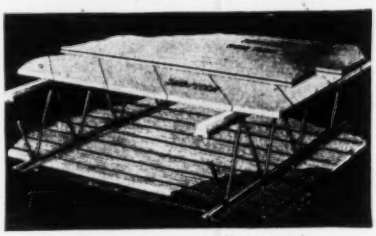
The instinct which prevents an animal from stepping on a rolling object is utilized in a railway cattle guard manufactured by the Conical Roller Cattle Guard Corporation, Anniston, Ala. This consists of welded angle iron sections, in each which are fitted

ROLLER GUARD KEEPS CATTLE OFF RAILWAY TRACK

twelve wooden rollers 23¼ in. long and varying in diameter from 4 to 4¼ in. Sections are spiked to the crossties at either end, two being used between the rails and one on each side outside of the rail. The steel framework is painted with asphalt paint and the wooden rollers are creosoted under pressure to lengthen the life of the device. Accidental damage is unlikely, as the guard is depressed below the head of the rail, and if struck by dragging brake equipment, the roller feature tends to protect it. However, in case of injury to any member, it can easily be replaced without taking off the section.

Wood Nailing Strip Forms Part of Steel Floor Joist

For residences, apartments, institutional buildings and other structures where wood floors are to be used the Truscon Steel Company, Youngstown, Ohio, has developed a nailer joist of the open-truss type to which the rough flooring may be fastened directly by nails. The joists are made of steel shapes electrically welded in the form of a Warren truss, the webs being



TYPICAL FLOOR CONSTRUCTION USING JOISTS WITH NAILER STRIPS

formed of electrically welded round bars. The nailing strip is held securely on the top chord by pressure embedment of the flanges, and its load-bearing capacity is not considered in the design. Joists are made in lengths from 8 to 24 ft., the lower chords of the end panels being inclined upward to a connection with the top chords. Special forms of anchors are provided for attachment to walls and steel beams, and clips are available for attaching metal lath to the lower part of the joist.

Reinforcing Incorporated in Base for Plaster

Wire mesh reinforcement in combination with a waterproofed paper backing as a base for plaster has been improved by the National Steel Fabric Company, Pittsburgh, Pa., by the addition of horizontal V-shaped steel ribs which stiffen the sheet, cause it to lie perfectly flat, and eliminate the necessity of stretching or toe-nailing. The material, known as Ribbed Steeltex, can be

PLASTERING WALLS WITH IMPROVED REINFORCEMENT

cut with ordinary hand shears and can be bent to fit corners or curved surfaces. Sheets are made in a standard size 50x 28½ in. The illustration shows a typical application, with the finished plaster coating at the top, the ground coat beneath, below that the steeltex reinforcing and at the bottom a rear view of the opposite reinforcing showing the horizontal ribs.

New Publications

Graders — AUSTIN-WESTERN ROAD MACHINERY COMPANY, Chicago, Ill., has issued several additional bulletins describing the various graders produced by the company.

Graders—FOOTE BROS. GEAR & MACHINE COMPANY, Chicago, Ill., has prepared a 32-p. illustrated catalog of its entire line of road grader equipment.

Concrete Pipe—LOCK JOINT PIPE COMPANY, Ampere, N. J., has issued a bulletin, which consists largely of illustrations, showing in detail the construction of pipe lines in which lock joint pipe has been used.

Garage Construction—PORTLAND CEMENT ASSOCIATION, Chicago, Ill., devotes a 23-p. illustrated booklet to the consideration of modern garage construction, with particular attention to the ramp method of vertical transportation.

Reinforcing Steel—RAIL STEEL BAR ASSOCIATION, Chicago, Ill., gives information on the manufacture, properties and use of rail steel bars in a 15-p. illustrated booklet, "Rail Steel for Concrete Reinforcing."

Drill Sharpeners—SULLIVAN MACHINERY COMPANY, Chicago, Ill., devotes bulletin 72-M, 16 pp., to a description of the Sullivan light model drill sharpener, designed to serve in connection with lighter drills utilizing ¾- to 1-in. steel. This sharpener weighs 1,100 lb., being particularly adaptable for contractors' use.

Road Machinery—GOOD ROADS MACHINERY COMPANY, INC., Kennett Square, Pa., in three new bulletins gives specifications of the Senior roller in 4- and 5-ton sizes, the Autograder driven by a self-contained power unit, and the Motograder using the model 20-K Cletrac tractor as the power unit.

Air Compressors and Vacuum Pumps—PENNSYLVANIA PUMP AND COMPRESSOR COMPANY, Easton, Pa., has published a 24-p. illustrated bulletin 147 showing details of single-stage, double-acting straight-line air compressors and vacuum pumps built by the company and describing the method of compressor regulation used.

Welding Wire—PAGE STEEL & WIRE COMPANY, Bridgeport, Conn., has issued a small folder telling why welding wire must be subjected to a special processing in order to produce good welds, and also explaining the importance of using the highest grade of iron and steel in manufacture. The pamphlet gives standard sizes of welding wire and tells the particular type of wire best adapted for various jobs.

Rock Asphalt—KENTUCKY ROCK ASPHALT COMPANY, Louisville, Ky., tells in narrative form the story of the development and increasing use of natural rock asphalt as a paving material in a 16-p. illustrated booklet. The company has also issued a Kyrock handbook containing 48 pp. giving engineering data relating to its products, including a large number of cross-sections showing the methods of applying natural rock asphalt surfacing to old highway foundations.

Tractors—CATERPILLAR TRACTOR COMPANY, San Leandro, Calif., has issued an interesting booklet, "The Romance of Caterpillar Tractors," telling in a series of brief episodes many varying jobs which can be done by tractor power.

Concrete Floors and Buildings—PORTLAND CEMENT ASSOCIATION, Chicago, Ill., in a 23-p. illustrated booklet tells how to secure durable and economical concrete floors by the proper control of materials and workmanship. This includes typical working specifications and a discussion of floor hardeners. The association has also prepared a 48-p. illustrated booklet, "Monolithic Concrete Buildings," treating of the use of reinforced concrete in building construction and its architectural possibilities. Illustrations show many beautiful structures of this material.

The Business Side of Construction

Construction and Production Are Above Last Year

ENGINEERING construction contracts in the first eight months are 20 per cent greater in value than in 1928; for the first seven months, 25 per cent. Seven months' figures now available for many materials and other factors show major business prospering and less favorable conditions prevailing in those lines that depend more on small building activity.

Steel production has made a record this year, with unfilled tonnage 14 per cent more than last year. Automobile production is up 39 per cent for passenger cars and 78 per cent for trucks. Shipments of railroad locomotives number 388, compared with 360, and orders for 539 were on the books on July 31, compared with 198 last year.

As gages of general industry and business, public utility kilowatt-hour production and check payments were both 14 per cent greater than in 1928. New capital issued this year amounted to 36 per cent more than last.

It is worth noting that for July, though power production increased 3 per cent over June, bank debits 31 per cent and new capital 19 per cent, engineering construction declined 7 per cent. Another decline, 8.5 per cent, was registered in August. Some significance may attach to the fact that bank debits estimated for August are exactly 31 per cent over those of August, 1928, the same difference as for July.

The August rate for lettings was $70,000,000 per week, compared with $76,500,000 in July, $74,500,000 a year ago, and $82,500,000 average this year. The total for the month is $349,695,000.

The gain for the year continues to be chiefly in private construction (up 32 per cent); public up 2 per cent. Streets and roads, the only important backward influence this year, is now within 14 per cent of last year.

Cement Price Break Feature of the Market

An outstanding price cut was reported last week. With steel, lumber and brick prices unchanged and in local instances actually higher, cement has broken all along the line. Producers of other major materials have been endeavoring throughout the year to hold production to needs. Not so with cement; seven months' production amounts to 2.3 per cent more than the shipments. The break has been sudden and sharp (see table, p. 394).

Steel demand and output have been consistently high throughout the year, the gain for each being 11 per cent. By classes the per cent gains are:

Fabricated plate, orders	11.5
Boilers, orders	14.2
Unfilled tonnage	14.3
Barrels, shipments	15.4
Ingots, production	18.1
Fabricated shapes, shipments	18.3
Fabricated shapes, orders	22.0
Commercial castings, production	30.6
Commercial castings, orders	43.5

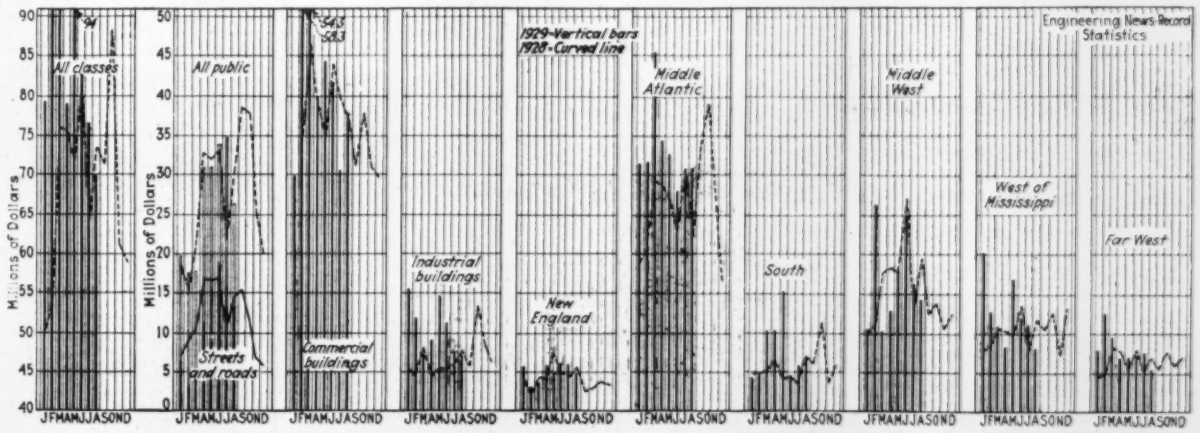
At present Pittsburgh producers find structural steel buying spotty, with good volume of small orders for reinforcing bars. Plate mills are six weeks behind orders, with heavy autumn buying looked for. Prices of heavy hot-rolled materials remain steady at $1.95—the price since April; $1.85 a year ago. Wire nails dropped 20c. per keg, due to high output and decreasing demand because of the replacement of wood by steel and fiber.

The softwood industry continues to operate below last year's activities, with only scattered price changes. Demand for boat space for canned goods is expected to stiffen the price of water-borne pine and fir this month. A favorable position has been maintained through the reduction of gross stocks. The outlook is rendered still more favorable by a prospective dealer demand for yard stocks 1.2 per cent larger than in the first half of the year. A favorable selling market has been maintained by producers of North Carolina pine, Northern

VALUE OF CONTRACTS BY SECTIONS IN THE UNITED STATES AND TOTAL FOR CANADA, AUGUST, 1929
Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States August, 1929	United States Year to Date 1929	United States Year to Date 1928	Canada August, 1929
Water-works	$702	$398	$69	$379	$1,190	$1,400	$4138	$29,989	$36,359	$633
Sewers	766	1,554	398	2,839	623	412	6,592	59,935	69,712	362
Bridges	573	7,542	867	1,329	3,295	912	14,518	96,798	87,439	289
Excavations, etc	49	105	231	75	15	120	595	19,375	23,239	1,142
Streets and roads	2,252	21,452	6,989	10,571	19,545	5,463	66,272	386,614	448,688	2,190
Industrial buildings	3,728	5,005	13,345	7,240	1,475	4,642	35,435	375,210	209,990	1,768
Commercial buildings	13,927	103,101	2,735	45,073	10,392	11,985	187,213	1,457,222	1,309,704	6,839
Federal government	16	539	9,784	343	1,528	1,009	13,219	82,712	42,997	
Unclassified	1,339	14,765	233	2,921	2,158	297	21,713	387,869	169,486	11,477
August, 1929*	23,352	154,461	34,651	70,770	40,221	26,240	349,695			24,700
July, 1929†	24,135	119,148	23,589	64,557	44,993	29,682	306,104			28,312
August, 1928*	26,693	110,846	38,251	96,793	59,186	35,794	367,563			15,449
Year to date, 1929	174,249	1,148,934	275,233	574,177	447,291	275,840		2,895,724		147,310
Year to date, 1928	165,511	877,840	178,552	596,682	355,225	223,804			2,397,614	107,004

*Five weeks. †Four weeks.



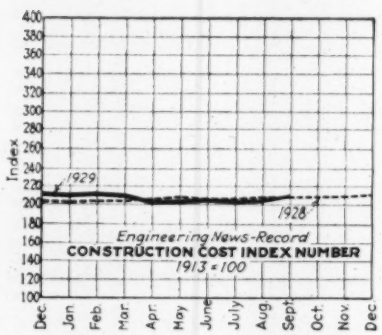
CONTRACTS AWARDED—AVERAGE WEEK PER MONTH—TOTAL U. S. BY CLASSES—ALL CLASSES BY SECTIONS

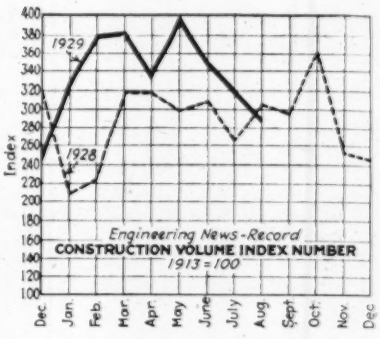
hardwoods and Northwest products. Elsewhere, however, surplus production has created a buyers' market. On the matter of price changes during the month, pine timbers are down 50c. in Boston, up $1 in Kansas City (fir also up $1), down $2.50 in Atlanta, up 50c. in New York.

Cement mills are cutting 10c. to 30c. per barrel, with dealers passing the cut along. Manufacturers blame imports. The market situation is that demand has declined at a greater rate than production, and reserve stocks have increased 8 per cent. Steady production and keen competition from home and abroad broke the market. In contrast, when a similar situation faced the Hudson River brick district, production was reduced 84 per cent. As against this, only one cement mill (at Norfolk) has shut down. During August, efforts at curtailment have been instituted on the Coast and in the Gulf region, with the natural consequence of keen competition in the Central states.

Brick producers in the Greater New York district were finding foreign competition most uncomfortable. They could maintain production with the prospect of lower prices or they could curtail. They chose the latter alternative, closing sixteen of the nineteen yards in the district. Prices in the last month increased 50c. to $14 delivered in Manhattan. It is noteworthy that a number of the plants closed are open-yard and will probably not operate again, as the tendency is toward modern machinery and year-around operation. Demand is 50 per cent less than a year ago, due to the dwelling house slump. Atlanta reports a price rise of 75c.; Denver a decline of $1.

Finishing lime increased in New York 10c. per barrel for standard and $1 per ton for hydrated, common remaining unchanged. Southern common advanced $2 per ton in Atlanta.





ENGINEERING NEWS-RECORD CONSTRUCTION COST AND VOLUME INDEX NUMBERS

Cast-iron pipe prices dropped $2 in Burlington and New York. Although the formal base at Birmingham remains $38, sales are admittedly being made at $37. The formal August price at Chicago was $49.20 for 4-in. and $46.20 for 6-in. or more. During this month the city purchased 1,668 tons for $48.05 for 4-in. and $45.05 for 8- to 12-in.

Several price declines in sand and gravel are noted this month. Crushed stone prices are unchanged.

Nationwide declines of ½c. to 3c. are reported for manila rope.

Construction Cost and Volume Index Numbers

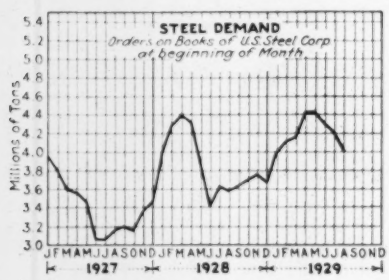
E. N.-R. Cost		E. N.-R. Volume*	
Sept., 1929	**207.57**	**Aug. 1929**	**290**
Aug., 1929	205.91	July, 1929	320
Sept., 1928	207.29	Aug., 1928	306
Peak June, 1920	273.80	1928 (average)	287
1928 (average)	206.78	1927 (average)	263
1913 (average)	100.00		
1928		1928	
January	203.90	January	208
February	204.65	February	225
March	204.65	March	318
April	206.40	April	316
May	207.00	May	299
June	206.15	June	308
July	206.65	July	266
August	207.29	August	306
September	207.29	September	296
October	207.71	October	363
November	209.46	November	251
December	210.16	December	244
1929		1929	
January	209.46	January	325
February	210.40	February	378
March	207.78	March	382
April	203.40	April	332
May	205.15	May	395
June	205.65	June	347
July	204.77	July	320
August	205.91	August	290

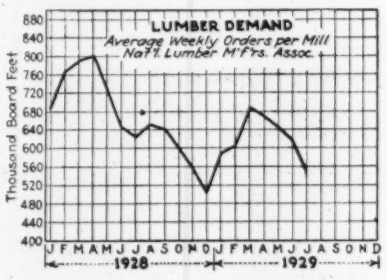
*Corrected for price change since 1913.

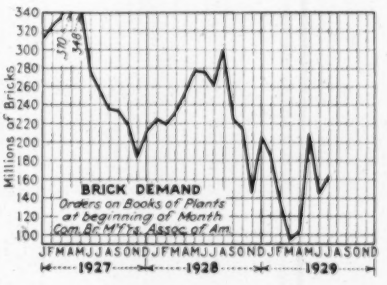
Many Wage Settlements Reported

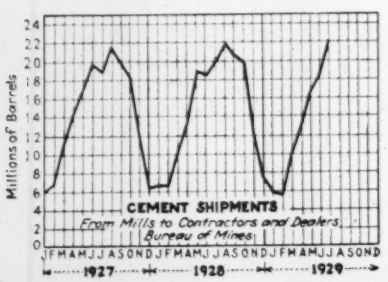
New York—Forty trades, or 115,000 men, received the five-day week with 10 per cent wage increase Aug. 24. This concludes a series of disputes that disturbed the labor market since February. Settlements not yet made with painters and electrical workers. Painters, who have been working five days for some time, demand the 10 per cent wage increase and threaten strike. Electrical workers have agreed to arbitrate their differences with the fixture manufacturers.

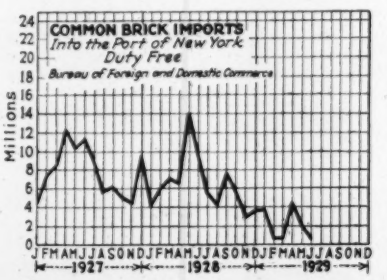
Philadelphia—Building trades mechanics, on strike one week during Au-

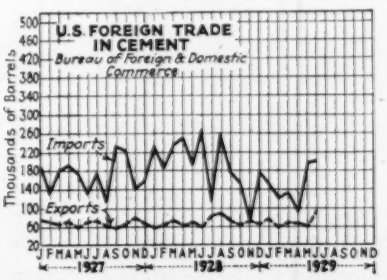

STEEL DEMAND
Orders on Books of U.S. Steel Corp. at Beginning of Month
Millions of Tons
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929


LUMBER DEMAND
Average Weekly Orders per Mill
Nat'l. Lumber M'f'rs. Assoc.
Thousand Board Feet
J F M A M J J A S O N D J F M A M J J A S O N D
1928 1929


BRICK DEMAND
Orders on Books of Plants at beginning of Month
Com. Br. M'f'rs. Assoc. of Am.
Millions of Bricks
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929


CEMENT SHIPMENTS
From Mills to Contractors and Dealers
Bureau of Mines
Millions of Barrels
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929


COMMON BRICK IMPORTS
Into the Port of New York
Duty Free
Bureau of Foreign and Domestic Commerce
Millions
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929


U.S. FOREIGN TRADE IN CEMENT
Bureau of Foreign & Domestic Commerce
Imports
Exports
Thousands of Barrels
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929

DEMAND FOR BASIC CONSTRUCTION MATERIALS—IMPORTS

CURRENT BUILDING AND CONSTRUCTION TRADES WAGE RATES PER HOUR

Advances since last month are indicated by **heavy type**; declines by *italics*

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor*
Atlanta	$1.25@1.40	$0.60@.70	$0.60@1.00	$0.50	.....	$0.75@1.25	$0.25@.35
Baltimore	1.75	1.00@1.10	1.37½	.65	$1.00@$1.25	1.00@1.25	.35
Birmingham	1.50	1.00	1.25	.50	.....	1.75	.20@.35
Boston	1.50	1.37½	1.37½	.85	1.27½	1.37½	.45@.80
Cincinnati	1.62½	1.40	1.40	1.00	1.40	1.40	.40@.60
Chicago	1.62½	1.56½	1.56½	.90	1.56½	1.62½	**.35**
Cleveland	1.62½	**1.37½**	1.37½	.87½	1.10	1.50	.40@.87½
Dallas	1.67½	1.12½	1.25	.35 @ .75	1.25	1.25	.30 @ .50
Denver	1.50@1.62½	1.25	1.25@1.37½	.87½@1.00		1.25	.37½@.62½
Detroit	1.56½	1.00@1.25	1.00@1.10	.90	1.00@1.10	1.00@1.25	.37½@.60
Kansas City	1.37½	**1.37½**	1.25	.90	1.25@**1.37½**	*1.25	**.35@.90**
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.50
Minneapolis	1.25@1.37½	.87½@.95	.87½	.75	.....	1.00	.40@.60
Montreal	1.25	.80	.75	.40	.....	1.00	.30@.35
New Orleans	1.50	.90	1.25	.75	.80@1.00	1.25	.30@.40
New York	1.87½	**1.65**	**1.92½**	**1.18¾**	**1.10@1.23¾**	**1.92½**	**1.03**
Philadelphia	1.62½	1.12½@1.25	1.02½	.70@1.12½	1.00	1.37½@1.50	.45@.50
Pittsburgh	1.70	1.50	1.43¾@1.56¼	1.12½	.....	1.50	.40@.80
St. Louis	1.75	1.50	1.50@1.65	1.15@1.25	1.25	1.62½	.40@.87½
San Francisco	1.37½	1.12½	1.12½	.87½	1.12½	1.37½	.50@.60
Seattle	1.50	1.12½	1.25	1.00	1.12½	1.25	.70

*Minimum rates are for construction other than buildings, non-union.

gust, have returned. The trouble, which involved payment below scale, has been settled satisfactorily.

Plainfield, N. J.—Ironworkers ended two weeks' strike, returning under previous conditions. All differences adjusted.

Washington—Hoisting engineers and employers reached agreement Aug. 19 whereby present scale and working conditions are to remain until Sept. 1, 1932. Officers of local union have filed suit against the international body, charging interference with the jurisdictional rights of the local.

Boston—Ironworkers still on strike over question of jurisdictional right to perform certain classes of work. Architects report scarcity of new projects and few sketches on hand for further work.

Shamokin, Pa.—About 800 men walked out on a coal breaker project near here, charging the contractors required men to work longer than eight hours a day.

Denver—Amicable settlement near in strike of laborers for $5 per day and eight hours, as men return to jobs.

St. Louis—Some 200 electricians of Belleville, East St. Louis and Granite City, Ill., on strike two weeks, returned Aug. 12 pending settlement of claims for 25c. per hour increase, to $1.75. Men work under old scale until board adopts new retroactive schedule.

Evansville—Plumbers, iron and sheet metal workers, steamfitters and electricians strike in protest against hiring non-union plumbers.

Chicago—Hourly wages advanced Sept. 1 as follows: plasterers, 7½c. ($1.70); windlass and niggerhead men, 5c. ($1.10); caisson diggers, 5c. ($1.25); building laborers, 5c. (95c.). Electrical workers receive 7½c. ($1.70) Oct. 1, 1929.

Cleveland—Five-day week effective Aug. 31 throughout building trades for three years but without pay advance.

Toronto—Carpenters' locals urged to consolidate for higher scale. Unions will adopt strike tactics only as a last resort.

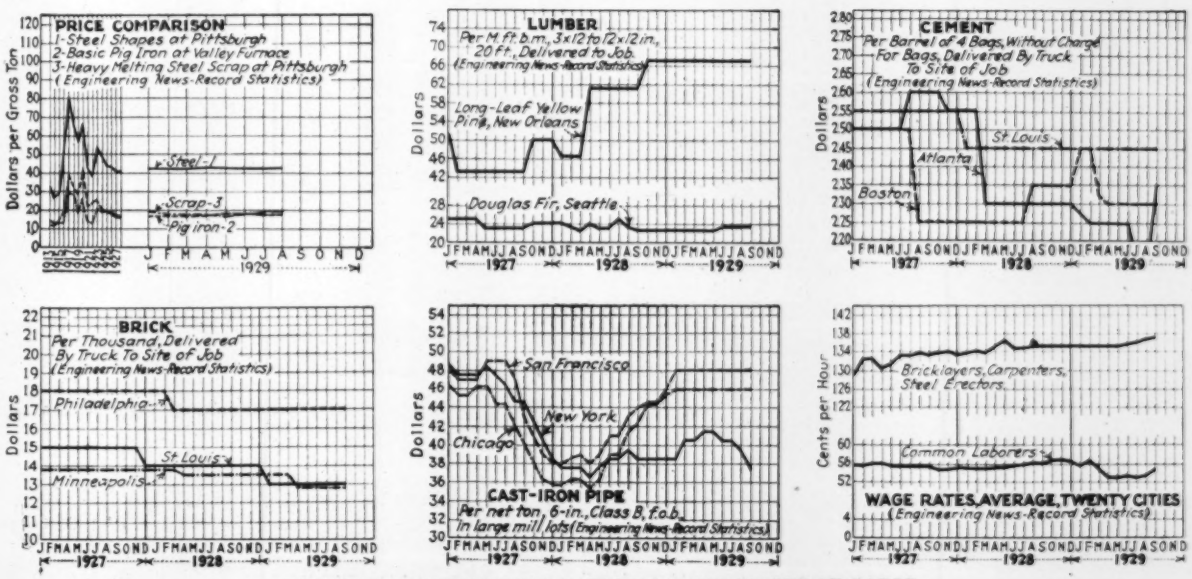
Skilled building trades mechanics receive an average rate of $1.37 per hour, compared with $1.36¾ in August and $1.35 a year ago. The average skilled rate in manufacturing is 67.2c.

Common laborers' average is 54.90c., against 53.53c. in August and 56.07c. in September, 1928. The average unskilled rate in manufacturing is 50.4c. per hour.

Government to Abandon Its Contract Letting System

As the result of recent tie-ups in federal building projects in Washington and Cleveland due to labor difficulties, Treasury Department officials have decided to abandon the policy of attempting to deal directly with separate contractors for various parts of the work. In the future, it is stated, all of the work will be let to the lowest-bidding general contractor, thus freeing the government from the responsibility of co-ordinating the operations or from the necessity of adjusting disputes between union and non-union contractors.

The recent trouble was brought about by the refusal of the union labor employed by the contractor for the structural work on an addition to the Printing Office to remain on the same job with non-union workers employed by the contractor for the mechanical work. As the government recognizes neither union nor non-union labor in such cases and must accept the lowest bid, it was powerless to avert the disagreement and the resulting tie-up. The general contractor, it is pointed out, does not have to accept the lowest bidder for special parts of the work and can thereby avoid bringing union and non-union men together on the same job.


PRICE COMPARISON
1-Steel Shapes at Pittsburgh
2-Basic Pig Iron at Valley Furnace
3-Heavy Melting Steel Scrap at Pittsburgh
(Engineering News-Record Statistics)
Dollars per Gross Ton
Steel-1
Scrap-3
Pig Iron-2
J F M A M J J A S O N D
1929
LUMBER
Per M ft b.m., 3x12 to 12x12 in., 20 ft., Delivered to Job
(Engineering News-Record Statistics)
Dollars
Long-Leaf Yellow Pine, New Orleans
Douglas Fir, Seattle
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
CEMENT
Per Barrel of 4 Bags, Without Charge for Bags, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
Dollars
St. Louis
Atlanta
Boston
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
BRICK
Per Thousand, Delivered By Truck To Site of Job
(Engineering News-Record Statistics)
Dollars
Philadelphia
St. Louis
Minneapolis
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
CAST-IRON PIPE
Per net ton, 6-in., Class B, f.o.b. in large mill lots (Engineering News-Record Statistics)
Dollars
San Francisco
New York
Chicago
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929
WAGE RATES, AVERAGE, TWENTY CITIES
(Engineering News-Record Statistics)
Cents per Hour
Bricklayers, Carpenters, Steel Erectors
Common Laborers
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927 1928 1929

PRICES OF CONSTRUCTION MATERIALS AND WAGES OF LABOR

Current Prices of Construction Materials

Price advances since last month are indicated by **heavy type**; declines by *italics*

Building Materials

PORTLAND CEMENT—Prices per bbl., quoted by manufacturers and dealers, delivered by truck to contractors, *without charge for bags*. Cash discount not deducted.

	Sept. 5, 1929	One Month Ago	One Year Ago
Atlanta	$2.35	$2.10	$2.30
Baltimore	*2.40*	2.65	2.65
Birmingham	2.60	2.60	2.60
Boston	2.25@2.35	2.25@2.35	2.35
Cedar Rapids (f. o. b.)	*2.04*	2.24	2.24
Chicago (f. o. b.)	*1.85*	2.05	2.05
Cincinnati (f. o. b.)	*1.92*	2.17	2.22
Cleveland (f. o. b.)	*1.94*	2.04	2.24
Dallas	2.15	2.15	2.40
Davenport (f. o. b.)	*2.04*	2.24	2.24
Denver	2.55	2.55	2.85
Detroit (f. o. b.)	1.95	1.95	1.95
Duluth (f. o. b.)	*1.84*	2.04	2.04
Indianapolis, (f. o. b.)	*1.89*	2.09	2.19
Jersey City	2.60	2.60	2.35
Kansas City, Mo.	2.65	2.55	2.20
Los Angeles	*2.32*	2.86	2.66
Milwaukee (f. o. b.)	*2.00*	2.20	2.20
Minneapolis (f. o. b.)	*2.02*	2.22	2.22
Montreal (f. o. b.)	1.70	1.70	1.41
New Orleans	2.65	2.65	2.20
New York	*2.10*	2.25	2.25@2.35
Peoria (f. o. b.)	*2.02*	2.22	2.22
Philadelphia	2.40	2.40	2.41
Pittsburgh (f. o. b.)	*1.85*	2.05	2.04
St. Louis	2.45	2.45	2.45
St. Paul (f. o. b.)	*2.02*	2.22	2.22
San Francisco	2.41	2.41	2.41
Seattle	2.70	2.70	2.70
Toledo (f. o. b.)	*2.03*	2.20	2.20

Current mill-prices per barrel, in carloads, without bags, f.o.b.:

Alpena, Mich.	$1.65	Lehigh Valley District	$1.55
Buffington, Ind.	*1.60*	Limedale, Ind.	1.80
Clinchfield, Ga.	1.65	Mason City, Ia.	1.80
Hannibal, Mo.	1.90	Norfolk, Va.	1.90
Houston, Tex.	1.95	North Birmingham, Ala.	*1.25*
Hudson, N. Y.	*1.55*	Richard City, Tenn.	1.70
Ironton, Ohio	*1.50*	Steelton, Minn.	*1.65*
Iola, Kan.	1.85	Universal, Pa.	*1.60*
La Salle, Ill.	1.90	Wyandotte, Mich.	1.70

SAND AND GRAVEL—Dealers' quotations per cu.yd. delivered. Weight of sand, 1½ tons per cu.yd.; gravel, 1½ tons per cu.yd., unless otherwise specified in pounds.

	Gravel		Sand
	1½ In.	¾ In.	
Atlanta, per ton	$2.65	$2.65	$2.00
Baltimore, per ton	2.40	2.60	1.70
Birmingham (2,600 lb.)	3.00	3.00	2.65
Boston, per ton	1.90	1.90	1.25
Chicago	1.90	1.90	*1.80*
Cincinnati, per ton	*1.65*	*1.65*	*1.40*
Cleveland (3,000) (2,700)	2.60	2.60	2.50
Dallas	2.60	2.60	2.60
Denver (2,700 lb.)	1.80	1.80	1.30
Detroit (2,600 lb.)	3.25	3.25	2.75
Kansas City, Mo.			
Los Angeles, per ton	2.15	2.15	1.30
Minneapolis (2,800 lb.) (3,000 lb.)	2.40	2.40	1.10
Montreal, per ton	1.90	1.90	1.20
New Orleans (2,700 lb.) (2,500 lb.)	3.75	3.75	2.75
New York	3.25	3.25	2.00
Philadelphia, per ton	2.30@3.15	2.30@3.15	1.50@2.31
Pittsburgh, per ton	1.55	1.55	1.75
St. Louis, per ton	2.35	2.25	2.00
San Francisco (2,800 lb.)	1.75	1.75	1.50
Seattle (3,200 lb.) (2,850 lb.)	1.75	1.75	1.75

Note: New York gravel weighs 2,800@3,000 lb. and sand, 2,700 lb.

CRUSHED STONE—Dealers' quotations per cu.yd., delivered. Weight, 1½ tons per cu.yd., unless otherwise specified in pounds:

	1½ In.	¾ In.
Atlanta, per ton	$2.65	$2.65
Baltimore, per ton	2.75	2.85
Birmingham, Limestone	3.00	3.25
Boston, per ton	2.25	2.25
Chicago, Limestone (2,500)	1.90	1.90
Cincinnati, per ton	*2.25*	*2.25*
Cleveland, per ton (2,500)	2.70	2.70
Dallas	3.25	3.40
Denver, Granite (2,700 lb.)	2.50	2.50
Detroit, Limestone, per ton (2,500)	3.00	3.00
Kansas City, Limestone	2.00	2.00
Los Angeles, per ton	2.15	2.15
Minneapolis, Limestone (2,600 lb.)	2.40	2.40
Montreal, per ton	2.10	2.10
New York, Limestone	3.25	3.25
Philadelphia, Limestone, per ton	2.30@3.15	2.30@3.15
Pittsburgh per ton	2.75	2.75
St. Louis per ton 2,400 lb. per cu.yd.)	1.95	1.95
San Francisco, Trap rock (2,400 lb.)	1.65	1.65
Seattle, (2,700 lb.)	1.90	1.90

CRUSHED SLAG—Manufacturers' quotations on crushed slag in carloads, per net ton, at plant:

	1½-In.	¾-In.	Roofing	Sand
Birmingham, Ala.	$0.90	$1.15	$2.05	$0.55
Buffalo District	1.25	1.35	2.25	1.25
Cleveland, Ohio	1.15	1.15	.....	.80
Eastern Pa. and Northern N. J.	1.25	1.25	2.00	1.25
Toledo, Ohio	1.25	1.25	1.50	1.25
Western Pennsylvania	1.25	1.25	2.00	1.25
Youngstown District	1.30	1.40	2.00	1.30

HOLLOW TILE—Dealers' quotations on hollow building tile per block, delivered to contractors in lots of 2,000 pieces or over:

	4x12x12	6x12x12	8x12x12	10x12x12	12x12x12
Atlanta	$0.072	$0.099	$0.135	$0.181	$0.202
Baltimore	.105		.20		.26
Birmingham	.09	.127	.174	.218	.261
Boston	.085	**.115**	**.155**	.1875	.255
Chicago	.076	.104	.142	.182	.202
Cincinnati	*.066*	*.09*	*.125*	*.16*	*.18*
Cleveland	.064	.088	.128	.171	.19
Dallas	**.098**	.12	**.18**	**.296**	
Denver	.0975	.135	.175	.2125	.25
Detroit	.098	.135	.184	.24	.265
Kansas City	.0525	.077	.158		.242
Los Angeles	.085	.122	.175	.232	.285
Minneapolis	*.0611*	*.081*	*.1060‡*	*.1402*	*.1787*
Montreal	.12*		.22†		
New Orleans	.086	.118	.16	.212	.256
New York	.0864	.1296	.162		
Perth Amboy, N.J. (f.o.b.)				.2388	.2956
Philadelphia	.105	.14	.215	.28	.34
Pittsburgh	.068		.1175		.1726
St. Louis	.078	.104	.145	.175	.21
San Francisco	.108	.156	.255		
Seattle	.085	.115	.18		

*4x4x12. †8x8x12.

BRICK—Dealers' quotations, delivered, per thousand are as follows:

		Paving	
	Common	3x8½x4-in.	3½x8½x4-in
Atlanta	**$13.50**	$38.00*	$45.00†
Baltimore	14.00	40.00	46.00
Birmingham	15.00	30.00*	34.00†
Boston	16.50	43.00	48.00
Chicago	12.00	42.00	45.00
Cincinnati	18.00	40.00	45.00
Cleveland	14@16	33.00	36.00
Dallas	14.50	35.00	.....
Denver	*11.00*		
Detroit	15.50	34.50	38.50
Kansas City	14.00	.....	.....
Los Angeles	**12.00**	.....	.....
Minneapolis	12.75	.....	.....
Montreal	20.33	.....	.....
New Orleans	16.50	40.00*	50.50
New York	**34@35**	45.00	51.00
Philadelphia	17.00	40.00	46.00
Pittsburgh	17.00	40.50	45.00
St. Louis, salmon	13.00	40.00	42.50
San Francisco	14.50	40.00	45.00
Seattle	14.00	50.00	55.00

*2½x8½x4 in. †3x8½x4.

LIME—Dealers' quotations, delivered to job:

	Hydrated, per Ton		Lump, per Barrel	
	Finishing	Common	Finishing	Common
Atlanta	$21.00	**$13.50**		
Baltimore	20.00	14.00	$2.55†	.....
Birmingham	22.00	16.00	3.00†	$2.00†
Boston	21.00	14.50	3.80*	2.90*
Chicago	18.00	14.00	18.00‡	1.35†
Cincinnati	*15.30*	*12.70*	.....	.....
Cleveland	20.00	16.00	2.50†	2.50†
Dallas	20.00	.....	.....	18.00‡
Denver	32.00	23.75	3.80*	3.00*
Detroit	19.20	14.80	2.20†	2.20†
Kansas City	16.00	12.50	.....	2.50†
Los Angeles	25.00	18.00	2.85†	17.00‡
Minneapolis	25.50	21.00	.....	1.70†
Montreal	19.75	.....	.....	15.00‡
New Orleans	.....	.....	2.60†	1.60†
New York	21@**23**	14@15	**4.10@4.20**	3.15@3.25*
Philadelphia	22.00	15.00	.....	.....
Pittsburgh	**21.00**	19.00	.....	.....
St. Louis	24.00	18.00	2.75†	15.00‡
San Francisco	27.50	20.00	.....	1.70†
Seattle, paper sacks	36.00	24.00	.....	2.80†

*Per 280-lb. bbl. (net). †Per 180-lb. (net). ‡Per ton.

CONCRETE BLOCKS—Manufacturers' quotations on standard, 8x8x16-in., hollow, delivered to job, each:

Boston	*$0.17*@.20	Minneapolis	$0.15
Brooklyn and Queens	.12@.14	New Orleans	.22
Cleveland	.16@.17	Philadelphia	.18@.25
Denver	.22	Pittsburgh	.20
Detroit	.15	St. Louis	.18

SLATE—Roofing, f.o.b., quarry, Bangor, Pa., net, per square:

No. 1 Clear	$9.45@$13.05
No. 1 Ribbon	8.10@ 9.23
Medium Clear	8.55@10.13

Road and Paving Materials

PAVING STONE—Dealers' quotations, f.o.b., in carloads or in cargo lots, for granite blocks, 4x8x4-in., dressed:

Atlanta	$3.[illegible] per sq.yd.
Baltimore	3.[illegible] per sq.yd.
Boston	135.00 per M.
Chicago, 5 in.	3.25@3.50 per sq.yd.
Cincinnati	110.00 per M.
Cleveland	115@120 per M.
Detroit, 5 in.	3.00 per sq.yd.
Kansas City	[illegible].[illegible] per sq.yd.
Minneapolis, Sandstone, 4½x8x[illegible]	2.80 per sq.yd.
Montreal	104.75 per M.
New Orleans	2.80 per sq.yd.
New York, 5 in., Grade 1, 30 blocks per sq.yd.	150.00 per M.
Philadelphia	125.00 per M.
St. Louis, 4x5x8 to 12 in.	3.50 per sq.yd.
San Francisco, Basalt block, 4x7x8 in.	70.00 per M.

Current Prices of Construction Materials

Road and Paving Materials—Continued

WOOD-BLOCK PAVING—Dealers' quotations, f.o.b., in carloads:

	Size of Block	Treatment	Per Sq.Yd.
Atlanta	3½	16	$2.25
Boston	3½	16	**2.55**
Chicago	3½	12	2.10
Cincinnati	3½	16	2.25
Dallas	3½	18	3.90
Kansas City	3½	16	2.75
Minneapolis	3½	16	2.75
Montreal	4	16	4.50
New Orleans	3½	16	2.50
New York	3½	16	2.70
St. Louis	3½	16	2.30

FLAGGING—Dealers' quotations, alongside dock, New York: Manhattan and Bronx, 4 ft. wide, 24c. per sq.ft.; Queens, 5 ft. wide, 26c. per sq.ft.

CURBING—Dealers' quotations: *New York*: Bluestone, f.o.b. barge, New York, 5x16 in., rough, 90c. per lin.ft., cutting charges extra. *Birmingham*: Limestone, 5x18-in., f.o.b., $1.05 per lin.ft. *St. Louis*: Class "B" straight, 5x16 in., f.o.b., $1.00 per lin.ft.; roundings, $1.50 per lin.ft.

ASPHALT—Manufacturers' quotations per ton in packages (350-lb. bbls. or 425-lb. drums); also in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
Atlanta (Mexican)	*$20.40*	*$16.40*
Baltimore (Standard Oil, f.o.b. refinery)	21.75	17.75
Birmingham (Mexican)	27.00	23.00
Boston (Mexican)	23.50	18.00
Chicago (Texas)	23.50	19.30
Cincinnati (Kentucky Rock)		12.30
Cleveland	24.00	20.00
Dallas (Texas)	**24.75**	
Denver (California)	35.00	
Detroit (Mexican)	19.72	15.69
Kansas City, Mo. (Texas)	**27.30**	**22.30**
Los Angeles ("D" Grade, California, f.o.b., El Segundo)	18.00	12.00
Maurer, N. J. (Bermudez)	30.00	
Maurer, N. J. (Trinidad)	25.00	
Minneapolis, (Stanolind, f.o.b., Twin Cities)	24.10	19.10
Montreal (Imperial)	28.00	21.50
New Orleans (Texas)	24.00	21.00
New York (Texas)	22.50	18.50
Philadelphia (Mexican)	18.00	15.00
Pittsburgh (Standard Oil)	24@26	14@18
St. Louis (Mexican)	21.50	17.50
San Francisco, (f.o.b. refinery, Oleum, Calif.)	18.00	12.00
Seattle, ("D" grade, California, f.o.b., Richmond refinery)	19.50	13.50

ROAD OILS—Manufacturers' quotations, f.o.b., in tank cars, 8,000 gal. minimum, per gal.:

Birmingham, 40@50% asphalt	$0.0525
Birmingham, 50@60% asphalt	.0525
Dallas, 40@50% asphalt	.06
Dallas, 50@60% asphalt	.06
New York, 40@50% asphalt (at terminal)	.05
New York, 50@60% asphalt (at terminal)	.05
St. Louis, 40@50% asphalt	.0342
St. Louis, 50@60% asphalt	.0357

Iron and Steel

PIG IRON—Producers' quotations, per gross ton, f.o.b.:

Birmingham, No. 2 fdry., silicon 1.75@2.25	*$14.00*@$14.50
Pittsburgh, basic, incl. freight ($1.76) from Valley	20.26

STRUCTURAL STEEL—Manufacturers' and dealers' quotations per 100 lb.:

	Shapes, 3 to 15-In.	Plates, ¼-In
Birmingham, large mill lots, f.o.b.	$2.15	$2.15
Chicago, warehouse, delivered	3.10	3.10
Cleveland, warehouse, delivered	3.00	3.00
Dallas, warehouse, delivered	**3.75**	**3.75**
New York, warehouse, delivered, up to 3,999 lb.	3.30	3.30
Pittsburgh, large mill lots, f.o.b., (Aug. 29, 1929)	1.95	1.95
St. Louis, warehouse, delivered	3.25	3.25
San Francisco, warehouse, delivered	3.15	3.15

BARS, CONCRETE REINFORCING—Manufacturers' and dealers' quotations on bars rolled from billets, per 100 lb. for ¾-in.:

Birmingham, large mill lots, f.o.b.	$2.15
Chicago, warehouse, delivered	*2.15*@3.00
Cleveland, warehouse, delivered	2.25@2.44
Dallas, warehouse, delivered	**3.65**
New York, warehouse, delivered, over 5 tons	2.90
Pittsburgh, large mill lots, stock lengths, f.o.b.	**2.05**
St. Louis, warehouse, delivered	3.15
San Francisco, warehouse, delivered	2.25

EXPANDED METAL LATH—Dealers' quotations per 100 sq.yd., painted, delivered to job in less-than-carload lots:

Lb. per Sq. Yd.	New York	Birmingham	Chicago	St. Louis	Dallas	San Francisco
2.2	$17.50@$19.00	$26.00	$24.50	$22.00	*$20.00*	$28.50
2.5	18.50@ 20.00	27.00	25.50	23.00	*22.00*	29.50
3.0	20.00@ 21.00	29.00	27.00	25.00		32.00
3.4	22.00@ 22.50	30.50	28.00	26.50	*28.00*	34.00

WIRE REINFORCEMENT FOR CONCRETE—Manufacturers' quotations per 100 sq.ft. in carloads at mills; and dealers, delivered in lots of 10,000 sq.ft. or over; plain 4 in. by 4 in. mesh:

Style Number	Weight in Pounds per 100 sq.ft.	Pitts-burgh Mill	Chicago District Mill	——Warehouse Delivery—— New York	St. Louis	Dallas	San Fran-cisco
032	22	$0.99	$1.01	$1.39	$1.45	$1.13	$1.22
049	28	1.26	1.29	1.76	1.80	1.38	1.55
068	35	1.54	1.58	2.18	2.25	1.67	1.91
093	40	1.98	2.03	2.79	2.90	2.00	2.46
126	57	2.45	2.51	3.45	3.55	2.55	3.03
153	68	2.92	2.99	4.13	4.25	3.15	..
180	78	3.35	3.43	4.73	4.85	3.47	..

STEEL SHEETS—Manufacturers' and dealers' quotations per 100 lb., base:

	Blue Annealed No. 10 *	Black No. 24	Galvanized No. 24
Chicago, warehouse, delivered	$3.35	$4.05	$4.90
Cleveland, warehouse, delivered	3.25	3.90	4.75
New York, warehouse, delivered	3.90†	4.00	4.75
Pittsburgh, large mill lots, f.o.b.	2.20	2.85@**2.95**	3.50@**3.70**
St. Louis, warehouse, delivered	3.45	4.25	5.10
San Francisco, warehouse, delivered	3.80	4.90	5.30

*Light plates. †Up to 3,999 lb.

WIRE ROPE—Discounts from manufacturers' list price on regular grades of bright and galvanized, Eastern Territory, New York and East of Missouri River:

	Base
Cast steel round strand rope	20%
Galvanized iron rigging and guy rope (add to list)	12½%
Galvanized steel rigging and guy rope	7½%
Plow steel round strand rope	35%
Round strand iron and iron tiller	5%
Special and extra iron cast steel, round strand rope	**27½%**

Discount 5 points less than discount for Eastern territory: California, Oregon, Nevada, Washington, Wyoming, New Mexico, Colorado, North Dakota, Nebraska, Kansas, Oklahoma and Texas. Discount 10 points less than discount for Eastern territory: Arizona, Montana, Idaho and Utah.

RIVETS—Manufacturers' and dealers' quotations on structural rivets, round-head, ½-in., full kegs, per 100 lb.:

Chicago, warehouse, delivered	$4.00
Dallas, warehouse, delivered	4.90
New York, warehouse, delivered	4.50*
Pittsburgh, large mill lots, f.o.b.	3.10
St. Louis, warehouse, delivered	3.95
San Francisco, warehouse, delivered	5.65
Seattle, warehouse, delivered	5.50

*This price is for full kegs; broken kegs are $5.00 per 100 lb.

STEEL SHEETPILING—The manufacturers' base price, f.o.b., Pittsburgh, for large mill lots is $2.25 per 100 lb.

TERNE PLATE—I C, 8-lb. coating, 20x28-in., f.o.b., Pittsburgh mill:

Per package	$11.20

SHIP SPIKES—Dealers' quotations per 100 lb., black, from warehouse stocks; galvanized are about $1.75 per 100 lb. higher:

	½-In.	⅝-In.	¾-In.
San Francisco	$5.55	$5.10	$4.95
Seattle	7.75	5.65	5.50

Pittsburgh mill base in lots of 200 kegs or more, $3.00 per 100 lb.

WIRE NAILS—Dealers' quotations per 100 lb. keg, base, delivered from warehouse stocks, also Pittsburgh mill base:

Pittsburgh Mill	Birmingham	Chicago	St. Louis	Dallas	San Francisco	Montreal
$2.45@$2.55	$3.30	$3.20	$3.05	*$1.45*	$3.35	$4.95

SCRAP—The prices following are, f.o.b., per ton, paid by dealers:

	New York Per Gross Ton	Chicago Per Gross Ton	Detroit Per Gross Ton
No. 1 railroad wrought	$12.00@$12.50	**$15.50@$16.00**	*$14.50*
Stove plate	8.00@ 8.50	**13.50@ 14.00**	*9.00*
No. 1 machinery cast	*12.50@ 13.00*	16.00@ 16.50	**13.00***
Machine shop turnings	**7.50@ 8.00**	**8.00@ 8.50**	**9.50**
Cast borings	7.00@ **7.75**	**10.25@ 10.75**	*9.00*
Railroad malleable	14.00@ 14.50	**17.00@ 17.50**	*13.50*
Re-rolling rails	*12.75@ 13.25*	**18.00@ 18.50**	
Re-laying rails, 56@60 lb.	23.00@ 24.00	23.00@ 25.00	
Heavy melting steel, No. 1	12.75@ 13.25	**15.25@ 15.75**	14.75
Iron and steel pipe	*10.25@10.75*	**10.50@ 11.00**	8.75@ 10.50

*Net ton.

FREIGHT RATES—On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carload lots of 36,000 lb. or 18 tons:

Atlanta	$0.58	Detroit	$0.29
Baltimore	.31	Kansas City	.71†
Birmingham	.58	New Orleans	.67
Boston	.365	New York	.34
Buffalo	.265	Pacific Coast (all rail)	1.15*
Chicago	.34	Philadelphia	.32
Cincinnati	.27	St. Louis	.405
Cleveland	.19	St. Paul	.60
Denver	1.15*		

*Minimum weight on structurals, 60,000 lb. †Except iron or steel pipe and fittings.

Railway Materials and Supplies

STEEL RAILS—Manufacturers' quotations per gross ton, f.o.b., for large mill lots:

	Pittsburgh	Birmingham	Chicago
Standard openhearth rails	$43.00	$43.00	$43.00
Light rails, 25 to 45 lb.	36.00	34@36	34@36
Re-rolled rails	34.00	34@36	34@36

RAILWAY TIES—Dealers' quotations, f.o.b., for fair-sized orders:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
New York	Long-leaf sap pine, untreated	$1.10	$1.30
	Creosoted—prices on application		
Birmingham	Southern pine, untreated	1.10	1.25
	Southern pine, creosoted	1.60	1.75
Chicago	White oak, untreated	1.40	1.78
	Oak, empty cell, creosoted	1.80	2.40
	Oak, zinc treated	1.60	2.10
	Southern pine, creosoted	1.60	2.10
St. Louis	White oak, untreated	1.15	1.60
	Red oak, creosoted	1.45	2.05
San Francisco	Sap pine or cypress, untreated	.90	1.20
	Douglas fir, green, untreated	.82	1.14
	Douglas fir, empty cell, creosoted	1.73	2.32
Montreal	Birch or maple, untreated	.75@1.25	.75@1.25
	Birch or maple, creosoted	1.20@1.30	1.50@1.60

Current Prices of Construction Materials

Railway Supplies—Continued

TRACK SUPPLIES—Manufacturers' and dealers' quotations per 100 lb., f.o.b., Pittsburgh mill, for large mill lots, together with warehouse prices at other places named:

	Pittsburgh	Chicago	Birmingham	St. Louis	San Francisco
Standard spikes, ½-in. and larger	$2.80	$3.55	$3.50	$3.65@$3.95	$3.85
Track bolts	3.80	4.55	4.50	4.80@4.95	4.85
Standard section angle bars, splice bars or fish plates	2.75	3.40	3.50	.....	.....

Tie plates: Price at Pittsburgh and Chicago mills, $2.15 per 100 lb.

Pipe

WROUGHT-STEEL PIPE—Discounts from manufacturers' and dealers' standard lists:

	1 to 3-In. Butt Weld		2½ to 6-In. Lap Weld	
	Black	Galvanized	Black	Galvanized
Chicago, warehouse, delivered	54%	41%	51%	38%
Cleveland, warehouse, delivered	55½%	43½%	53½%	40½%
New York, warehouse, delivered	50%	36%	45%	32%
Pittsburgh, large mill lots, f.o.b.	62%	50½%	59%	47½%
St. Louis, warehouse, delivered	49%	36%	46%	33%

CAST-IRON PIPE—Prices of U. S. Pipe & Foundry Co., per net ton, for bell and spigot pipe, Class B and heavier, f.o.b., on regular lots of pipe:

	4-In.	6-In. and Over
Birmingham mill	$41.00	$38.00
Burlington (N. J.) mill	*38.00*	*35.00*
Chicago	49.20	46.20
New York	*50.60*	*37.60*
Pittsburgh	49.50	46.50
St. Louis	46.60	43.60
San Francisco	51.00	48.00

Gas pipe and Class A, $3.00 per ton extra.

SEWER PIPE—Dealers' quotations, delivered, per foot, for standard pipe; 6, 8 and 12-in. are single strength and 18, 24, 30 and 36-in. are double strength:

	6-In.	8-In.	12-In.	18-In.	24-In.	30-In.	36-In.
Atlanta	$0.13½	$0.22½	$0.75	.....	.....	.....	.....
Baltimore	.....	.30	.58	.....	$1.93	.....	$6.50
Birmingham	.25	.40	.65	$1.50	2.75	$3.90	5.83
Boston	.185	.30	.55	**1.325**	**2.20**	**3.60**	**6.00**
Chicago	.15	.28	.54	1.25	2.25	4.75	6.00
Cincinnati	*.145*	*.210*	*.405*	*.975*	**2.025**	**3.67**	**5.74**
Cleveland	.18	**.294**	**.567**	**1.35**	**2.43**	**4.824**	**7.38**
Dallas	.256	.42	**.81**	**1.80**	**3.10**	.....	.....
Denver	.161	.23	.414	.816	1.44	.....	.....
Detroit	.18	.28	.6075	1.50	2.70	5.12	7.91
Kansas City	.21	.29	.52	.....	1.90	3.80	.....
Los Angeles	.21	.2825	.51	1.186	2.03	3.39	5.09
Minneapolis	.16	.25	.50	1.15	1.84	3.49	4.97
Montreal	.36	.53	.78	1.48	2.75	4.20	.....
New Orleans	.195	.325	.585	1.10	2.11	.....	.....
New York	.185	.29	.56	1.35	2.45	4.60	7.07
Philadelphia	.117	.182	.351	1.05	1.89	3.60	5.6375
Pittsburgh	.0945	.147	.2835	.85	1.53	3.024	4.8175
St. Louis	.1645	.26	.468	1.092	1.872	3.65	4.80
San Francisco	.21	.30	.54	1.26	2.16	3.60	.....
Seattle	.22	.30	.54	1.26	2.16	3.60	.....

CLAY DRAIN TILE—Dealers' quotations, delivered, per 1,000 lin.ft.:

Size, In.	New York	Birm'ham	St. Louis	Dallas	San Fran.	Seattle
4	$55.00	$56.00	$50.00	$63.00	$67.50	60.00
6	112.00	**112.00**	*110.00*	110.00	112.50	112.00

Miscellaneous

LINSEED OIL—Dealers' quotations on raw oil, f.o.b., in 1- to 4-bbl. lots, per lb.:
New York ... **$0.136** Chicago ... **$0.138** Minneapolis ... **$0.144**

WHITE AND RED LEAD—Dealers' quotations per 100-lb. keg, base price, f.o.b., New York: White, dry or in oil, $13.75; Red, dry, $13.75; Red, in oil, $15.25.

CHEMICALS—Water, sewage treatment, road work, round lots in the New York market:

Sulphate of aluminum, iron free, in bags, per 100 lb.	$2.00@$2.10
Sulphate of copper, in bbl., per 100 lb.	6.00@ 6.10
Soda ash, 58%, in bags, per 100 lb.	1.32@ 1.35
Chlorine, cylinders, per lb.	.05@ .08
Bleaching powder, in drums, f.o.b. works, per 100 lb.	2.00@ 2.10
Calcium chloride, in drums, f.o.b. works, per ton	20.00

MANILA ROPE—The number of feet per pound for the various sizes is as follows: ½-in., 8-ft.; ¾-in., 6-ft.; 1-in., 4½-ft.; 1-in., 3½-ft.; 1¼-in., 2-ft., 10-in.; 1½-in., 2-ft., 4-in. Following are dealers' quotations per pound for ½-in. and larger, delivered in 1,200-ft. coils:

Atlanta	*$0.225*	Kansas City	*$0.26*
Baltimore	.225	Los Angeles	.25
Birmingham	.26	Minneapolis	.24
Boston	.23	Montreal	.245
Chicago	.22	New Orleans	.25
Cincinnati	.21	New York	.215
Cleveland	.21	Philadelphia	.24
Dallas	*.18*	San Francisco	.205
Denver	*.24*	Seattle	.205
Detroit	*.23½*	St. Louis	.215

BUILDING PAPER—Black, in carloads, per roll of 500 sq.ft., f.o.b., producing point $2.08

SLATERS FELT—In carloads, per roll, f.o.b., producing point $0.91½

ROOFING MATERIALS—Dealers' quotations, f.o.b., New York, to contractors in carloads:

Asphalt felt, per 100 lb.	$2.60
Tar felt, per 100 lb.	2.60
Asphalt coating, per gal.	.34½
Tar pitch, in 350 lb. barrels, per ton	28.00

PREPARED ROOFINGS—Dealers' quotations to contractors, in carloads, f.o.b., New York, per square.

Single shingles, slate finish, sufficient to cover 100 sq.ft.	$6.12½
Strip shingles, 4 in 1, hexagonal shape, with Underwriters' label	5.00
Slate surfaced roofing in rolls weighing 85 to 90 lbs.	2.50

WINDOW GLASS—United inches 25, bracket size 6x8 to 10x15, single or double thickness, discount from jobbers' list (Sept. 15, 1928), at New York warehouses:
AA ... 83% A ... 86% B ... 88%

EXPLOSIVES—Manufacturers' quotations per pound for dynamite delivered in small lots, under 200 lb.:

	Gelatin 40%	Gelatin 60%		Gelatin 40%	Gelatin 60%
Atlanta	$0.22	$0.245	Los Angeles, f.o.b.†	$0.1875	$0.2225
Baltimore	.215	.2375	Minneapolis	**.2275**	**.2525**
Birmingham	.22	.245	Montreal	.195	.22
Boston	.225	.25	New Orleans	.195	.22
Chicago	.195*	.22*	New York	.255‡	.2775‡
Cincinnati	.22	.245	Philadelphia	.215	.24
Dallas	**.1875**	**.228**	St. Louis	.215	.235
Denver, f.o.b.	.19	.2125	San Francisco	.1625	.1925
Kansas City, Mo.	.2025	.2225	Seattle	.16	.185

*Quantities above 500 lb. but less than a ton. †San Fernando Arsenal. ‡Special gelatin in case lots.

Lumber

Prices Are Per Thousand Feet, Board Measure

New York—Timbers, rough, delivered to contractor at site of job, in 20 ft. lengths and under, per M. ft., b.m.:

	Merchantable Long-leaf Yellow Pine	No. 1 Common Douglas Fir
3x4 to 8x8	**$57.50**	$43.00
3x10 to 10x10	65.00	43.00
3x12 to 12x12	75.00	46.00
3x14 to 14x14	87.50	50.00

Chicago—Dealers' quotations, f.o.b., in carloads, No. 1 Common, rough, per M. ft. b.m. For delivery to job from stock, in truckloads, add $10 per M. ft.:

	20 Ft. and Under Long-Leaf Yellow Pine	Up to 32 Ft. Douglas Fir
3x4 to 8x8	$43.00	$42.00
3x10 to 10x10	50.50	42.00
3x12 to 12x12	62.50	42.00
3x14 to 14x14	74.50	43.00

San Francisco—Dealers' quotations on rough Douglas fir, No. 1 common, at yards. For delivery to contractor at site of job, add $1.50 to $5 per M. ft.:

	10-16-18 and 20 Ft.	22 and 24 Ft.
3x3 and 4	$28.00	$29.00
3x6 and 8	28.00	29.00
3x10 and 12	28.00	29.00
3x14	31.00	33.00

Other Cities—Dealers' quotations, delivered, No. 1 Common, rough, per M. ft:

	8x8-In. x 20 Ft. and Under				3x12 to 12x12-In. 20 Ft. and Under	
	Pine*	Fir†	Hemlock	Spruce	Pine*	Fir†
Atlanta	**$55.00**	.....	.....	.....	*$65.00*	.....
Baltimore	36.00	$50.00	$53.50	$61.00	75.00	$50.25
Birmingham	45.00	.....	.....	.....	60.00	.....
Boston	**48.50**	47.00	47.50	48.50	**58.00**	52.00
Cincinnati	52.50	62.50	.....	.....	70.00	57.50
Cleveland	65.00	65.00	.....	.....	65.00	65.00
Dallas	65.00	57.50	57.50	55.00	65.00	57.50
Denver	.....	57.00	57.00	55.00	.....	55@58
Detroit	58.75	49.50	.....	.....	68.50	50.25
Kansas City, Mo	50.00	50.00	.....	.....	**56.00**	**56.00**
Los Angeles	.....	44.00	.....	.....	.....	44.00
Minneapolis	58.00	53.25	38.25‡	.....	58@60	53.25@54.75
Montreal	50.00	55.00	.....	.....	50.00	48.00
New Orleans	50.00	46.00	.....	44.00	67.00	63.00
Philadelphia	52.00	44.00	44.00	50.00	62.00	43@45
Pittsburgh	65.00	70.00	75.00	65.00	65.00	65@72
St. Louis	45.50	39.00	.....	.....	56.50	39.50
Seattle	.....	23.00	.....	.....	.....	23.50

	1x10 In. x 16 Ft. and Under			2x10 In. x 16 Ft. T. & Gr.	
	Pine*	Fir†	Hemlock	Pine*	Fir†
Atlanta	$60.00	.....	.....	**$42.50**	.....
Baltimore	56.00	$45.00	$45.00	.....	.....
Birmingham	36.00	.....	.....	43.00	.....
Boston	**45.00**	43.00	42.25	**48.50**	$47.50
Cincinnati	65.00	57.50	.....	42.00	55.00
Cleveland	60.00	55.00	.....	65.00	58.00
Dallas	60.00	.....	.....	.....	.....
Denver	.....	46.00	46.00	.....	50.00
Detroit	45.00	42.00	.....	46.50	44.00
Kansas City, Mo.	55.00	*46.00*	.....	**46.50**	**46.50**
Los Angeles	.....	38.00	.....	.....	57.00
Minneapolis	53.00	47.00	39.75‡	51.00	46.00
Montreal	56.00	48.00	40.00	.....	.....
New Orleans	43.00	40.00	.....	50.00	46.00
Philadelphia	53.00	44.00	42.00	57.00	45.00
Pittsburgh	50.00	60.00	59.00	42.00	.....
St. Louis	39.00	41.00	38.00	39.00	37.00
Seattle	.....	21.00	.....	.....	23.00

*Long-leaf yellow pine. †Douglas fir. ‡F.o.b.

PILES—Dealers' quotations per lineal foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.14½	$0.18
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.19	.23
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.21½	.25
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.25½	.34
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.27½	.36
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.33	.41
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.38	.41